

B.Tech 4th Semester Exam., 2022

(New Course)

OPERATING SYSTEMS

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.*
- (ii) There are **NINE** questions in this paper.*
- (iii) Attempt **FIVE** questions in all.*
- (iv) Question No. 1 is compulsory.*

1. Answer/Choose the correct answer of the following (any seven) : 2×7=14

- (a) What is the difference between a multiprocessor and a multicore system?*
- (b) What is multiprogramming?*
- (c) Define jacketing.*
- (d) What operations can be performed on a semaphore?*

- (e) What is the difference between a page and a frame?
- (f) In contiguous memory allocation
- (i) each process is contained in a single contiguous section of memory
 - (ii) all processes are contained in a single contiguous section of memory
 - (iii) the memory space is contiguous
 - (iv) None of the above
- (g) If the size of logical address space is 2^m to the power of m , and a page size is 2^n to the power of n addressing units, then the high order _____ bits of a logical address designate the page number, and the _____ low order bits designate the page offset.
- (i) m, n
 - (ii) n, m
 - (iii) $m-n, m$
 - (iv) $m-n, n$

- (h) If the wait for graph contains a cycle, then
- (i) a deadlock does not exist
 - (ii) a deadlock exists
 - (iii) the system is in a safe state
 - (iv) either deadlock exists or system is in a safe state
- (i) When the event for which a thread is blocked occurs?
- (i) Thread moves to the ready queue
 - (ii) Thread remains blocked
 - (iii) Thread completes
 - (iv) A new thread is provided
- (j) An I/O port typically consists of four registers—status, control, _____ and _____ registers.
- (i) system in, system out
 - (ii) data in, data out
 - (iii) flow in, flow out
 - (iv) input, output

2. (a) What is the purpose of interrupts? What are the differences between a trap and an interrupt? Can traps be generated intentionally by a user program? If so, for what purpose?

7

(b) Answer the following with full justifications : 7

(i) Does swapping improve or degrade the efficiency of system utilization?

(ii) Can swapping be used in a multi-programming system?

3. (a) Including the initial parent process, how many processes are created by the program shown below? 7

```
#include<stdio.h>
#include<unistd.h>
int main()
{
    /*fork a child process */
    fork();
    /* fork another child process*/
    fork();
    /* and fork another */
    fork();
    return 0;
}
```

(b) Describe the differences among short-term, medium-term, and long-term scheduling. 7

4. (a) An airline reservation system, using a centralized database service, user requests concurrently. Is it preferable to use threads rather than processes in this system? Give reasons for your answer. 7

- (b) Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O-bound tasks issue an I/O operation once for every millisecond of CPU computing and that each I/O operation takes 10 milliseconds to complete. Also assume that the context-switching overhead is 0.1 millisecond and that all processes are long-running tasks. Describe the CPU utilization for a round-robin scheduler when—

- (i) the time quantum is 1 millisecond;
- (ii) the time quantum is 10 milliseconds.

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5. (a) Clearly justify why deadlocks cannot arise in a bounded buffer producers-consumers system.

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- (b) Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock-free.

7

6. Five batch jobs, A through E, arrive at a computer center at essentially the same time. They have an estimated running time of 15, 9, 3, 6 and 12 minutes, respectively. Their (externally defined) priorities are 6, 3,

7, 9 and 4, respectively, with a lower value corresponding to a higher priority. For each of the following scheduling algorithms, determine the waiting time for each process and the average waiting for all jobs. Ignore process switching overhead. Explain how you arrived at your answers. In the last three cases, assume that only one job at a time runs until it finishes and that all jobs are completely processor bound : 14

- (a) Priority scheduling
- (b) FCFS (run in order 15, 9, 3, 6 and 12)
- (c) Shortest job first

7. A bridge on a busy highway is damaged by a flood. One-way traffic is to be instituted on the bridge by permitting vehicles traveling in opposite directions to use the bridge alternately. The following rules are formulated for use of the bridge :

- (a) At any time, the bridge is used by vehicle(s) traveling in one direction only.
- (b) If vehicles are waiting to cross the bridge at both ends, only one vehicle from one end is allowed to cross the bridge before a vehicle from the other end starts crossing the bridge.

- (c) If no vehicles are waiting at one end, then any numbers of vehicles from the other end are permitted to cross the bridge.

Develop a concurrent system to implement these rules.

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8. (a) Consider a simple paging system with the following parameters :

- 232 bytes of physical memory
- Page size of 210 bytes
- 216 pages of logical address space

- (i) How many bits are in a logical address?
- (ii) How many bytes are in a frame?
- (iii) How many bits in the physical address specify the frame?
- (iv) How many entries are in the page table?

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- (b) Given five memory partitions of 100 KB, 500 KB, 200 KB, 300 KB and 600 KB (in order). How would the first-fit, best-fit, and worst-fit algorithms place processes of 212 KB, 417 KB, 112 KB and 426 KB (in order)? Which algorithm makes the most efficient use of memory?

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- (i) The marks are indicated in the right-hand margin.
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- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

Q.1 Answer any seven question of the following:

[2 x 7 = 14]

- (a) A computer system has 9 tape drives, with n processes competing for them. Each process may need 3 tape drives. The maximum value of n for which the system is guaranteed to be deadlock free is
 - (i) 9
 - (ii) 7
 - (iii) 8
 - (iv) 6
- (b) Which of the following page replacement algorithms suffers from Belady's anomaly ?
 - (i) Optimal replacement
 - (ii) LRU
 - (iii) FIFO
 - (iv) Both (a) and (c)
- (c) Scheduling a process from ready Queue to CPU is done by
 - (i) Short term scheduler
 - (ii) Middle term scheduler
 - (iii) Long term scheduler
 - (iv) Dispatcher
- (d) The time to move the disk arm to the desired cylinder in hard disk is known as
 - (i) rotational latency
 - (ii) seek time
 - (iii) positional time
 - (iv) disk time
- (e) Compaction is used to solve the problem of
 - (i) external fragmentation
 - (ii) internal fragmentation
 - (iii) both (a) and (c)
 - (iv) None of these
- (f) _____ is a technique of improving the priority of process waiting in queue for CPU allocation.
 - (i) starvation
 - (ii) Ageing
 - (iii) Revocation
 - (iv) Relocation
- (g) The CPU utilization is low when the system is
 - (i) timesharing
 - (ii) thrashing
 - (iii) multiprocessing
 - (iv) None of the above
- (h) When a process waits indefinitely for some resources which are being used by other processes, it is called
 - (i) Starvation
 - (ii) Demand Paging
 - (iii) Segmentation
 - (iv) None of the above
- (i) Fork is used to
 - (i) dispatch a task
 - (ii) create a new job
 - (iii) create a new process
 - (iv) increase the priority of a task
- (j) Which one of the following is the deadlock avoidance algorithm ?
 - (i) Banker's algorithm
 - (ii) Round-robin algorithm
 - (iii) Elevator algorithm
 - (iv) Karn's algorithm

Q.2 (a) Explain the concept of a process. With the help of a state transition diagram, discuss the various process states. **[7]**

(b) Describe the differences among short term, medium-term, and long-term scheduling. **[7]**

Q.3 (a) What are the various allocation policies in variable partition multiprogramming? Explain the differences between internal and external fragmentations. **[7]**

(b) What do you understand by address binding? Explain the various address binding schemes. **[7]**

- Q.4** (a) What are the differences between user-level threads and kernel-level threads? Under what circumstances is one type better than the other? [5]
- (b) What resources are used when a thread is created? How do they differ from those used when a process is created? [5]
- (c) Describe the actions taken by a kernel to context switch between kernel-level threads. [4]

- Q.5** (a) What do you understand by deadlock? Discuss the methods to avoid deadlock. [7]
- (b) State and explain the necessary and sufficient conditions for a deadlock. [7]

- Q.6** Consider the following process : [14]

Process	Arrival Time	Burst Time
P 1	0.0	7
P 2	2.0	4
P3	4.0	1
P 4	5.0	4

Considering non-preemptive and preemptive SJF algorithm, find out average waiting time and average turnaround time in both cases.

- Q.7** (a) What do you mean by critical section problem. Discuss Peterson's solution for critical section problem. [7]

- (b) Consider the following page reference string : [7]
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 following replacement algorithms? Assuming 3 frames are available. Also assume that initially none of pages in main memory.

- (i) Optimal replacement
(ii) FIFO replacement

- Q.8** (a) Suppose a disk drive has 300 cylinders, numbered 0 to 299. The current head position of the disk is at 90. The queue of pending requests, in FIFO order is 36, 79, 15, 120, 199, 270, 89, 170. Calculate the average cylinder movements for Shortest-Seek Time First (SSTF) algorithm. Mention the disadvantages of SSTF. [7]

- (b) Compare and contrast between linked and indexed disk allocation strategies. [7]

- Q.9** Write short notes on any two of the following : [7x2=14]

- (a) I-node
(b) Segmentation
(c) Thrashing
(d) Process Control Block



Bihar Engineering University, Patna

B.Tech 8th Semester Examination, 2024

Course: B.Tech

Code: 105403

Subject: Operating Systems

Time: 03 Hours

Full Marks: 70

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- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

Q.1 Choose the correct option / answer the following (Any seven question only):

[2 x 7 = 14]

- (a) Which memory allocation policy allocates the largest hole to the process
 - (i) Best Fit
 - (ii) First Fit
 - (iii) Worst Fit
 - (iv) None of these
- (b) What is the purpose of resource allocation graph
 - (i) to represent deadlock
 - (ii) to avoid deadlock
 - (iii) to detect deadlock
 - (iv) to prevent deadlock
- (c) Which scheduling policy is most suitable for a time shared operating system
 - (i) SJF
 - (ii) FCFS
 - (iii) Round Robin
 - (iv) Priority
- (d) Compaction is used to solve the problem of
 - (i) external fragmentation
 - (ii) internal fragmentation
 - (iii) both (i) and (ii)
 - (iv) none of these
- (e) The time to move the disk arm to the desired cylinder in hard disk is known as
 - (i) Rotational latency
 - (ii) Positional time
 - (iii) Seek time
 - (iv) Access time
- (f) Scheduling a process from Ready Queue to CPU is done by
 - (i) Short Term Scheduler
 - (ii) Long Term Scheduler
 - (iii) Middle Term Scheduler
 - (iv) Dispatcher
- (g) The CPU utilization is low when the system is
 - (i) Time sharing
 - (ii) Multiprocessing
 - (iii) Thrashing
 - (iv) None of these
- (h) is a technique of improving the priority of a process waiting in queue for CPU allocation.
 - (i) Revocation
 - (ii) Ageing
 - (iii) Starvation
 - (iv) Relocation
- (i) A computer system has 6 tape drives, with n processes competing for them. Each process may need 2 tape drives. The maximum value of n for which the system is guaranteed to be deadlock free is
 - (i) 6
 - (ii) 4
 - (iii) 5
 - (iv) 3
- (j) Virtual memory is
 - (i) an extremely large main memory
 - (ii) an illusion of an extremely large memory
 - (iii) an extremely large secondary memory
 - (iv) a type of memory used in supercomputer

- Q.2** (a) Discuss the various services provided by Operating Systems (OS). List the types of OS. [7]
 (b) Explain the life cycle of a process using process transition diagram. Discuss the various process states. [7]
- Q.3** (a) Explain paging with translation look-aside buffer (TLB) scheme with suitable diagram. [7]
 (b) Compare between thread and process. What are user-level and kernel-level threads? [7]
- Q.4** (a) Consider the following page reference string: [7]
 7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1.
 How many page faults would occur for the FIFO, LRU and Optimal page replacement algorithms, assuming demand paging with four frames? Remember that all frames are initially empty, so first unique pages will cost one fault each.
 (b) What are the various memory allocation policies in variable-partition multiprogramming. Explain the difference between internal and external fragmentation. [7]
- Q.5** (a) Consider the following four processes with following details (time given in ms): [7]
- | Process | Arrival Time | CPU Burst Time |
|---------|--------------|----------------|
| P1 | 0 | 12 |
| P2 | 0 | 10 |
| P3 | 1 | 4 |
| P4 | 4 | 10 |
| P5 | 2 | 12 |
- Draw the Gantt chart using RR scheduling with time slice 3ms. Calculate average waiting time and average turn-around time.
 (b) Write a program using “fork” to create a child process. Make explanations to demonstrate the parent-child relationship of processes. [7]
- Q.6** (a) Discuss critical section problem. Illustrate the classic software-based solution to this problem known as Peterson’s solution. [7]
 (b) State producer-consumer problem. Give a solution to this problem using semaphore. [7]
- Q.7** (a) Define and differentiate between deadlock and starvation? Explain necessary characteristics for deadlock to occur. [7]
 (b) What is deadlock avoidance mechanism? Discuss Banker’s algorithm to avoid deadlocks. [7]
- Q.8** (a) Discuss various file allocation methods (contiguous, linked, indexed) used by OS. [7]
 (b) Suppose a disk drive has 300 cylinders numbered 0 to 299. The current head position of the disk is at 90. The queue of pending requests in FIFO order is 36, 79, 15, 120, 199, 270, 89, and 170. Calculate the average cylinder movements for Shortest Seek Time First (SSTF) algorithm. Draw the head movement diagram also. Mention the disadvantages of SSTF. [7]
- Q.9** Write short notes on *any two* of the following:- [2 x 7 = 14]
 (a) I-Node
 (b) Thrashing
 (c) Belady’s Anomaly
 (d) Inverted Page Table