

No part of this publication may be reproduced or distributed in any form or any means, electronic, mechanical, photocopying, or otherwise without the prior permission of the author.

GATE SOLVED PAPER
Computer Science Engineering
Operating System

Copyright © By NODIA & COMPANY

Information contained in this book has been obtained by authors, from sources believes to be reliable. However, neither Nodia nor its authors guarantee the accuracy or completeness of any information herein, and Nodia nor its authors shall be responsible for any error, omissions, or damages arising out of use of this information. This book is published with the understanding that Nodia and its authors are supplying information but are not attempting to render engineering or other professional services.

NODIA AND COMPANY

B-8, Dhanshree Tower Ist, Central Spine, Vidyadhar Nagar, Jaipur 302039

Ph : +91 - 141 - 2101150

www.nodia.co.in

email : enquiry@nodia.co.in

GATE SOLVED PAPER - CS

OPERATING SYSTEM

YEAR 2001

- Q. 1 Which of the following statements is false ?
(A) Virtual memory implements the translation of a program's address space into physical memory address space.
(B) Virtual memory allows each program to exceed the size of the primary memory.
(C) Virtual memory increases the degree of multi-programming
(D) Virtual memory reduces the context switching overhead.
- Q. 2 Consider a set of n tasks with known runtimes r_1, r_2, \dots, r_n to be run on a uniprocessor machine. Which of the following processor scheduling algorithms will result in the maximum throughput ?
(A) Round-Robin (B) Shortest-Job-First
(C) Highest-Response-Ratio-Next (D) First-come-First-Served
- Q. 3 Where does the swap space reside ?
(A) RAM (B) Disk
(C) ROM (D) On-chip cache
- Q. 4 Consider a virtual memory system with FIFO page replacement policy. For an arbitrary page access pattern, increasing the number of page frames in main memory will.
(A) Always decrease the number of page faults
(B) Always increase the number of page faults
(C) Sometimes increase the number of page faults
(D) Never affect the number of page faults
- Q. 5 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
- Q. 6 Consider Peterson's algorithm for mutual exclusion between two concurrent processes i and j . The program executed by process is shown below.
repeat
 flag[i]=true;
 turn=j;
 while(p)do no-op;
 Enter critical section, perform actions, then
 exit critical section
 Flag[i]=false;
 Perform other non-critical section actions.

- Q. 12 In a system with 32 bit virtual addresses and 1 KB page size, use of one-level page tables for virtual to physical address translation is not practical because of
- (A) the large amount of internal fragmentation
 - (B) the large amount of external fragmentation
 - (C) the large memory overhead in maintaining page tables
 - (D) the large computation overhead in the translation process

YEAR 2003

TWO MARKS

- Q. 13 A uni-processor computer system only has two processes, both of which alternate 10 ms CPU bursts with 90 ms I/O bursts. Both the processes were created at nearly the same time. The I/O of both processes can proceed in parallel. Which of the following scheduling strategies will result in the least CPU utilizations (over a long period of time) for this system ?
- (A) First come first served scheduling
 - (B) Shortest remaining time first scheduling
 - (C) Static priority scheduling with different priorities for the two processes
 - (D) Round robin scheduling with a time quantum of 5 ms.

Common Data For Q. 14 & 15

A processor uses 2-level page table for virtual to physical address translation. Page table for both levels are stored in the main memory. Virtual and physical addresses are both 32 bits wide. The memory is byte addressable. For virtual to physical address translation, the 10 most significant bits of the virtual address are used as index into the first level page table while the next 10 bits are used as index into the second level page table. The 12 least significant bits of the virtual address are used as offset within the page. Assume that the page table entries in both levels of page tables are 4 bytes wide. Further, the processor has a translation look aside buffer (TLB), with a hit rate of 96%. The TLB caches recently used virtual page numbers and the corresponding physical page numbers. The processor also has a physically addressed cache with a hit ratio of 90%. Main memory access time is 10 ns, cache access time is 1 ns, and TLB access time is also 1 ns.

- Q. 14 Assuming that no page faults occur, the average time taken to access a virtual address is approximately (to the nearest 0.5 ns)
- (A) 1.5 ns
 - (B) 2 ns
 - (C) 3 ns
 - (D) 4 ns
- Q. 15 Suppose a process has only the following pages in its virtual address space; two contiguous code pages starting at virtual address 0×00000000 , two contiguous data pages starting at virtual address 0×00400000 , and a stack page starting at virtual address $0 \times FFFFFFF000$. The amount of memory required for storing the page tables of this process is
- (A) 8 KB
 - (B) 12 KB
 - (C) 16 KB
 - (D) 20 KB

Common Data For Q. 16 & 17

Suppose we want to synchronize two concurrent processes P and Q using binary semaphores S and T. The code for the processes P and Q is shown below.

Process P	Process Q:
while(1) {	while(1) {
W: print '0';	Y: print '1'
print '0';	print '1'
X: }	Z: }

Synchronization statements can be inserted only at points W,X,Y and Z.

- Q. 16 Which of the following will always lead to an output string with '001100110011'?
- (A) P(S) at W, V(S) at X, P(T) at Y, V(T) at Z, S and T initially 1
 - (B) P(S) at W, V(T) at X, P(T) at Y, V(S) at Z, S initially 1, and T initially 0
 - (C) P(S) at W, V(T) at X, P(T) at Y, V(S) at Z, S and T initially 1
 - (D) P(S) at W, V(T) at X, P(T) at Y, V(S) at Z, S initially 1, and T initially 0
- Q. 17 Which of the following will ensure that the output string never contains a substring of the form 0.1^n or 10^n1 where n is odd?
- (A) P(S) at W, V(S) at X, P(T) at Y, V(T) at Z, S and T initially 1
 - (B) P(S) at W, V(T) at X, P(T) at Y, V(S) at Z, S and T initially 1
 - (C) P(S) at W, V(S) at X, P(T) at Y, V(S) at Z, S initially 1
 - (D) (S) at W, V(T) at X, P(T) at Y, P(S) at Z, S and T initially 1

YEAR 2004.

ONE MARK

- Q. 18 Consider the following statements with respect to user-level threads and kernel-supported threads
- (i) Context switch is faster with kernel-supported threads
 - (ii) For user-level threads, a system call can block the entire process
 - (iii) Kernel-supported threads can be scheduled independently
 - (iv) User-level threads are transparent to the kernel
- Which of the above statements are true?
- (A) (ii), (iii) and (iv) only (B) (ii) and (iii) only
(C) (i) and (iii) only (D) (i) and (ii) only
- Q. 19 Consider an operating system capable of loading and executing a single sequential user process at a time. The disk head scheduling algorithm used is First Come First Served (FCFS). If FCFS is replaced by shortest seek Time First (SSTF), claimed by the vendor to give 50% better benchmark results, what is the expected improvement in the I/O performance of user programs?
- (A) 50% (B) 40%
(C) 25% (D) 0%
- Q. 20 The minimum number of page frames that must be allocated to a running process in a virtual memory environment is determined by
- (A) the instruction set architecture (B) page size
(C) physical memory size (D) number of processes in memory

YEAR 2004

TWO MARKS

Q. 21

Consider the following set of processes, with the arrival times and the CPU-burst times given in milliseconds

Process	Arrival time	Burst time
P1	0	5
P2	1	3
P3	2	3
P4	4	1

What is the average turnaround time for these processes with the preemptive shortest remaining processing time first (SRPT) algorithm?

- (A) 5.50 (B) 5.75
(C) 6.00 (D) 6.25

Q. 22

Consider a system with a two-level paging scheme in which a regular memory access takes 150 nanoseconds, and servicing a page fault takes 8 milliseconds. An average instruction takes 100 nanoseconds of CPU time, and two memory accesses. The TLB hit ratio is 99%, and the page fault rate is one in every 10,000 instructions. What is the effective average instruction execution time?

- (A) 645 nanoseconds (B) 1050 nanoseconds
(C) 1215 nanoseconds (D) 1230 nanoseconds

Q. 23

Consider two processes P_1 and P_2 accessing the shared variables X and Y protected by two binary semaphores S_x and S_y respectively, both initialized to 1. P and V denote the usual semaphore operators, where P decrements the semaphore value, and V increments the semaphore value. The pseudo-code of P_1 and P_2 is as follows:

P_1 : while true do { L_1 : L_2 : $X = X + 1$; $Y = Y - 1$; $V(S_x)$; $V(S_y)$; }	P_2 : while true do { L_3 : L_4 : $Y = Y + 1$; $X = X - 1$; $V(S_y)$; $V(S_x)$; }
--	--

In order to avoid deadlock, the correct operators at L_1, L_2, L_3 and L_4 are respectively

- (A) $P(S_y), P(S_x); P(S_x), P(S_y)$ (B) $P(S_x), P(S_y); P(S_y), P(S_x)$
(C) $P(S_x), P(S_x); P(S_y), P(S_y)$ (D) $P(S_x), P(S_y); P(S_x), P(S_y)$

Q. 24

A Unix-style I-node has 10 direct pointers and one single, one double and one triple indirect pointers. Disk block size is 1 Kbyte, disk block address is 32 bits, and 48-bit integers are used. What is the maximum possible file size?

- (A) 2^{24} bytes (B) 2^{32} bytes
(C) 2^{34} bytes (D) 2^{48} bytes

YEAR 2005

TWO MARKS

- Q. 25 Suppose n processes, P_1, \dots, P_n share m identical resource units, which can be reserved and released one at a time. The maximum resource requirement of process P_i is s_i where $s_i < 0$. Which one of the following is a sufficient condition for ensuring that deadlock does not occur?
- (A) $\forall i, s_i < m$ (B) $\forall i, s_i < n$
 (C) $\sum_{i=1}^n s_i < (m + n)$ (D) $\sum_{i=1}^n s_i < (m * n)$
- Q. 26 Consider the following code fragment:
- ```
if (fork() == 0)
{ a = a + 5; print f("%d,%d/n", a, and a); }
else { a = 5; print f("%d,%d/n", a, &a); }
```
- let  $u, v$  be the values printed by the parent process, and  $x, y$  be the values printed by the child process. Which one of the following is TRUE?
- (A)  $u = x + 10$  and  $v = y$  (B)  $u = x + 10$  and  $v \neq y$   
 (C)  $u + 10 = x$  and  $v = y$  (D)  $u + 10 = x$  and  $v \neq y$

YEAR 2006

ONE MARKS

- Q. 27 Consider three CPU-intensive processes, which require 10, 20 and 30 time units and arrive at times 0, 2, and 6, respectively. How many context switches are needed if the operating system implements a shortest remaining time first scheduling algorithm? Do not count the context switches at time zero and at the end
- (A) 1 (B) 2  
 (C) 3 (D) 4

YEAR 2006

TWO MARKS

- Q. 28 The atomic fetch-and-set  $x, y$  instruction unconditionally sets the memory location  $x$  to 1 and fetches the old value of  $x$  in  $y$  without allowing any intervening access to the memory location  $x$ . Consider the following implementation of P and V functions on a binary semaphore S.

```
void p (binary_semaphore*S){
 unsigned y;
 unsigned*x =& (S->value);
 do {
 fetch-and-set x,y;
 } while(y);
}
void v (binary_semaphore*S){
 {S->value = 0;
}
```

Which one of the following is true?

- (A) The implementation may not work if context switching is disabled in P  
 (B) Instead of using fetch-and-set, a pair of normal load/store can be used  
 (C) The implementation of V is wrong  
 (D) The code does not implement a binary semaphore

- Q. 29 A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer (TLB) which can hold a total of 128 page table entries and is 4-way set associative. The minimum size of the TLB tag is  
 (A) 11 bits (B) 13 bits  
 (C) 15 bits (D) 20 bits
- Q. 30 A computer system supports 32-bit virtual addresses as well as 32-bit physical addresses. Since the virtual address space is of the same size as the physical address space, the operating system designers decide to get rid of the virtual entirely. Which one of the following is true?  
 (A) Efficient implementation of multi-user support is no longer possible  
 (B) The processor cache organization can be made more efficient now  
 (C) Hardware support for memory management is no longer needed  
 (D) CPU scheduling can be made more efficient now
- Q. 31 Consider three processes (process *id* 0,1,2, respectively) with compute time bursts 2,4, and 8 time units. All processes arrive at time zero. Consider the longest remaining time first (LRTF) scheduling algorithm. In LRTF ties are broken by giving priority to the process with the lowest process *id*. The average turn around time is  
 (A) 13 units (B) 14 units  
 (C) 15 units (D) 16 units
- Q. 32 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 get 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?  
 (A) 0% (B) 10.6%  
 (C) 30.0% (D) 89.4%
- Q. 33 Consider the following snapshot of a system running  $n$  processes. Process  $i$  is holding  $x_i$  instances of a resource  $R$ , for  $1 \leq i \leq n$ . Currently, all instances of  $R$  are occupied. Further, for all  $i$ , process  $i$  has placed a request for an additional  $y_i$  instances while holding the  $x_i$  instances it already has. There are exactly two processes  $p$  and  $q$  such that  $y_p = y_q = 0$ : Which one of the following can serve as a necessary condition to guarantee that the system is not approaching a deadlock?  
 (A)  $\min(x_p, x_q) < \max_{k \neq p, q} y_k$  (B)  $x_p + x_q \leq \max_{k \neq p, q} y_k$   
 (C)  $\min(x_p, x_q) < 1$  (D)  $\min(x_p, x_q) > 1$

#### Common Data For Q. 34 & 35

Barrier is a synchronization construct where a set of processes synchronizes globally i.e. each process in the set arrives at the barrier and waits for all others to arrive and then all processes leave the barrier. Let the number of processes in the set be three and S be a binary semaphore with the usual P and V functions.



Consider the following C implementation of a barrier with line numbers shown on the left.

```

Void barrier(void) {
1 : P(S)
2 : Process_arrived++;
3 : V (S) :
4 : while (process_arrived!=3);
5 : P(S);
6 : Process_left++;
7 : if(process_left==3)
8 : process_arrived=0;
9 : process_left=0;
10 : }
11 : V(S);
}

```

The variable process\_arrived and process\_left are shared among all processes and are initialized to zero. In a concurrent program all the three processes call the barrier function when they need to synchronize globally.

Q. 34

The above implementation of barrier is incorrect. Which one of the following is true?

- (A) The barrier implementation is wrong due to the use of binary semaphore S
- (B) The barrier implementation may lead to a deadlock if two barrier invocations are used in immediate succession
- (C) Lines 6 to 10 need not be inside a critical section
- (D) The barrier implementation is correct if there are only two processes instead of three

Q. 35

Which one of the following rectifies the problem in the implementation?

- (A) lines 6 to 10 are simply replaced by process\_arrived
- (B) At the beginning of the barrier the first process to enter the barrier waits until process\_arrived becomes zero before proceeding to execute P(S)
- (C) Context switch is disabled at the beginning of the barrier and re-enabled at the end.
- (D) The variable process\_left is made private instead of shared

YEAR 2007

ONE MARK

Q. 36

Group-1 contains some CPU scheduling algorithms and group-2 contains some applications. Match entries in Group-1 entries in Group-2

| Group-1                      | Group-2                  |
|------------------------------|--------------------------|
| P. Gang Scheduling           | 1. Guaranteed Scheduling |
| Q. Rate Monotonic Scheduling | 2. Real-time Scheduling  |
| R. Fair Share scheduling     | 3. Thread Scheduling     |

(A) P-3;Q-2;R-1

(B) P-1;Q-2;R-3

(C) P-2;Q-3;R-1

(D) P-1;Q-3;R-2

- Q. 37 Consider the following statements about user level threads and kernel level threads. Which one of the following statements is FALSE?
- (A) Context switch time is longer for kernel level threads than for user level threads
  - (B) User level threads do not need any hardware support
  - (C) Related kernel level thread can be scheduled on different processors in a multiprocessor system
  - (D) Blocking one kernel level thread blocks all related threads

YEAR 2007

TWO MARKS

- Q. 38 An operating system uses Shortest Remaining Time first (SRT) process scheduling algorithm. Consider the arrival times and execution times for the following processes

| Process | Execution time | Arrival time |
|---------|----------------|--------------|
| P1      | 20             | 0            |
| P2      | 25             | 15           |
| P3      | 10             | 30           |
| P4      | 15             | 45           |

What is the total waiting time for process P2?

- (A) 5
  - (B) 15
  - (C) 40
  - (D) 55
- Q. 39 A virtual memory system uses first In First Out (FIFO) page replacement policy and allocates a fixed number of frames to a process. Consider the following statements:
- P: Increasing the number of page frames allocated to a process sometimes increases the page fault rate.
- Q: Some program do not exhibit locality of reference.
- Which one of the following is TRUE?
- (A) Both P and Q are true, and Q is the reason for P
  - (B) Both P and Q are true, but Q is not the reason for P
  - (C) P is false, but Q is true
  - (D) Both P and Q are false

- Q. 40 A single processor system has three resource types X, Y, and Z, which are shared by three processes. There are 5 units of each resource type. Consider the following scenario, where the column alloc denotes the number of units of each resource type allocated to each process, and the column request denotes the number of units of each resource type requested by a process in order to complete execution. Which of these processes will finish LAST?

|    | alloc |   |   | request |   |   |
|----|-------|---|---|---------|---|---|
|    | X     | Y | Z | X       | Y | Z |
| P0 | 1     | 2 | 1 | 1       | 0 | 3 |
| P1 | 2     | 0 | 1 | 0       | 1 | 2 |
| P2 | 2     | 2 | 1 | 1       | 2 | 0 |

- (A) P0
- (B) P1
- (C) P2
- (D) None of the above, since the system is in a deadlock

- Q. 41 Two processes, P1 and P2, need to access a critical section of code. Consider the following synchronization construct used by the processes:

```

/* P1 */
while (true) {
 wants1 = true;

 while(wants2 == true);
 /* Critical
 Section*/
 wants 1 = false;
}
/* Remainder section*/

/*P2*/
while (true) {
 wants2 = true;
 while (wants1 ==
 true);
 /* Critical
 Section*/
 wants 2 = false;
}
/*Remainder section*/

```

Here, wants 1 and wants 2 are shared variables, Which are initialized to false. Which one of the following statements is TRUE about the above construct?

- (A) It does not ensure mutual exclusion.
- (B) It does not ensure bounded waiting.
- (C) It requires that processes enter the critical section in strict alternation.
- (D) It does not prevent deadlocks, but ensures mutual exclusion

#### Common Data For Q. 42 & 43

A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1,2,1,3,7,4,5,6,3,1.

- Q. 42 If optimal page replacement policy is used, how many page faults occur for the above reference string?
- (A) 7 (B) 8  
(C) 9 (D) 10
- Q. 43 Least Recently Used (LRU) page replacement policy is a practical approximation to optimal page replacement. For the above reference string, how many more page faults occur with LRU than with the optimal page replacement policy?
- (A) 0 (B) 1  
(C) 2 (D) 3

YEAR 2008

ONE MARK

- Q. 44 Which of the following system calls results in the sending of SYN packets?
- (A) socket (B) bind  
(C) listen (D) connect
- Q. 45 The data block of a very large file in the Unix file system are allocated using
- (A) Contiguous allocation (B) Linked allocation  
(C) indexed allocation (D) an extension of indexed allocation

YEAR 2008

TWO MARKS

Q. 46

The P and V operations on counting semaphores, where  $s$  is a counting semaphore, are defined as follows:

$P(s); s = s - 1;$

if  $s < 0$  then wait;

$V(s); s = s + 1;$

if  $s \leq 0$  then wakeup a process waiting on  $s$ ;

Assume that  $P_b$  and  $V_b$  the wait and signal operations on binary semaphores are provided. Two binary semaphores  $X_b$  and  $Y_b$  are used to implement the semaphore operations  $P(s)$  and  $V(s)$  as follows:

$P(s) : P_b(X_b);$

$s = s - 1;$

if  $(s < 0)$  {

$V_b(X_b);$

$P_b(Y_b);$

}

else  $V_b(X_b);$

$P(s) : P_b(X_b);$

$s = s + 1;$

if  $(s \leq 0)$  {

$V_b(Y_b);$

$V_b(X_b);$

The initial values of  $x_b$  and  $y_b$  are respectively

(A) 0 and 0

(B) 0 and 1

(C) 1 and 0

(D) 1 and 1

Q. 47

Which of the following statements about synchronous and asynchronous I/O is NOT true?

(A) An ISR is invoked on completion of I/O in synchronous I/O but not in asynchronous I/O

(B) In both synchronous and asynchronous I/O an ISR (Interrupt Service Routine) is invoked after completion of the 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 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

Q. 48

Which of the following is NOT true of deadlock prevention and deadlock avoidance schemes?

(A) In deadlock prevention, the request for resources is always granted if the resulting state is safe

(B) In deadlock avoidance, the request for resources is always granted if the resulting state is safe

(C) Deadlock avoidance is less restrictive than deadlock prevention

(D) Deadlock avoidance requires knowledge of resource requirements a priori

Q. 49

A process executes the following code  $\text{for}(i = 0; i < n; i++) \text{fork}();$

The total number of child processes created is

- (A)  $n$  (B)  $2^n - 1$   
 (C)  $2^n$  (D)  $2^{n+1} - 1$

Q. 50

A processor uses 36 bit physical addresses and 32 bit virtual addresses, with a page frame size of 4 Kbytes. Each page table entry is of size 4 bytes. A three level page table is used for virtual-to-physical address translation, where the virtual address is used as follows

- bits 30-31 are used to index into the first level page table,
- bits 21-29 are used to index into second level page table
- bits 12-20 are used to index into third level page table
- bits 0-11 are used as offset within the page

The number of bits required for addressing the next level page table (or page frame) in the page table entry of the first, second and third level page table are respectively.

- (A) 20,20 and 20 (B) 24,24 and 24  
 (C) 24,24 and 20 (D) 25,25 and 24

YEAR 2009

ONE MARK

Q. 51

Consider a system with 4 type of resources R1 (3 units), R2 (2 units), R3 (3 units), R4 (4units). A non-preemptive resource allocation policy is used. At any give instance, a request is not entertained if it cannot be completely satisfied. Three processes P1, P2, P3 request the resources as follows if executed independently.

|                                                                                                                                                                                                                                     |                                                                                                                                                           |                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Process P1:<br>t=0; requests 2 units of R2<br>t=0; request 1 units of R3<br>t=0; request 2 units of R1<br>t=5; release 1 unit of R2 and 1 units of R1<br>t=7; release 1 units of R3<br>t=8; request 2 units of R4<br>t=10; Finishes | Process P2:<br>t=0 : request 2 units of R3<br>t=2 ; request 1 units of R4<br>t=4 ; request 1 units of R1<br>t=6 ; release 1 units of R3<br>t=8 ; Finishes | Process P3<br>t=0 ; request 1 units of R4<br>t=2 ; request 2 units of R1<br>t=5 ; release 2 units of R1<br>t=8 ; request 1 units of R3<br>t=9 ; Finishes |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|

Which one of the following statements is TRUE if all three processes run concurrently starting at time  $t = 0$  ?

- (A) All processes will finish without any deadlock  
 (B) Only P1 and P2 will be in deadlock  
 (C) Only P1 and P3 will be in deadlock  
 (D) All three processes will be in deadlock

- Q. 52 In which of the following page replacement policies, Belady's anomaly may occur  
 (A) FIFO (B) Optimal  
 (C) LRU (D) MRU

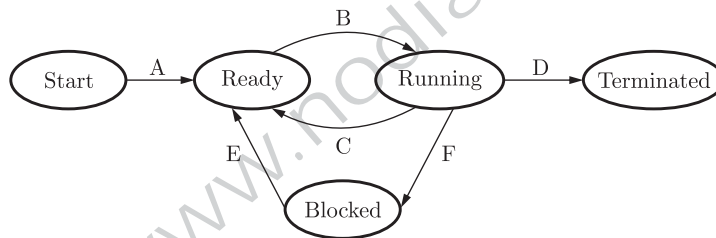
- Q. 53 The essential content(S) in each entry of a page table is/are  
 (A) virtual page number  
 (B) page frame number  
 (C) Both virtual page number and page frame number  
 (D) access right information

YEAR 2009

TWO MARKS

- Q. 54 Consider a disk system with 100 cylinders. The requests to access the cylinders occur in following sequence :  
 4, 34, 10, 7, 19, 73, 2, 15, 6, 20  
 Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1 ms to move from one cylinder to adjacent one and shortest seek time first policy is used ?  
 (A) 95 ms (B) 119 ms  
 (C) 233 ms (D) 276 ms

- Q. 55 In the following process state transition diagram for a uniprocessor system, assume that there are always some processes in the steady state :



Now consider the following statements :

- I. If a process makes a transition D, it would result in another process making transition A immediately  
 II A process  $P_2$  in blocked state can make transition E while another process  $P_1$  is in running state  
 III The OS uses non-preemptive scheduling  
 IV The OS uses non-preemptive scheduling  
 Which of the above statement are TRUE ?  
 (A) I and II (B) I and III  
 (C) II and III (D) II and IV

- Q. 56 The enter\_CS ( ) and leave\_CS ( ) functions to implement critical section of a process are realized using test and set instruction as follows :  
 Void enter\_cs (X)  
 {  
     while (test-and-set)(X)) :  
 }  
 Void leave\_CS(X)

```

{
 X=0;
}

```

In the above solution, X is a memory location associated with the CS and is initialized to 0. Now consider the following statements

- I The above solution to CS problem is deadlock-free
- II The solution is starvation free
- III The processes enter CS in FIFO order
- IV More than one process can enter CS at the same time

Which of the above statements are TRUE

- (A) I only
- (B) I and II
- (C) II and III
- (D) IV only

Q. 57

A multilevel page table is preferred in comparison to a single level page table for translating virtual address to physical address because

- (A) It reduces the memory access time to read or write and memory location
- (B) It helps to reduce the size of page table needed to implement the virtual address space of a process
- (C) It is required by the translation lookaside buffer
- (D) It helps to reduce the number of page faults in page replacement algorithms.

YEAR 2010

ONE MARK

Q. 58

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.

| Method used by P1                             | Method used by P2                                  |
|-----------------------------------------------|----------------------------------------------------|
| While (S1==S2);<br>Critical Section<br>S1=S2; | While (S1!=S2);<br>Critical Section<br>S2=not (S1) |

While one of the following statements describes properties achieved ?

- (A) Mutual exclusion but not progress
- (B) Progress but not mutual exclusion
- (C) Neither mutual exclusion nor progress
- (D) Both mutual exclusion and progress

Q. 59

A system uses FIFO policy for page replacement. It has 4 page frames with no pages loaded to begin with. The system first accesses 100 distinct pages in some order and then accesses the same 100 pages but now in the reverse order. How many page faults will occur ?

- (A) 196
- (B) 192
- (C) 197
- (D) 195

Q. 60

Which of the following statements are true ?

- I Shortest remaining time first scheduling may cause starvation
- II Preemptive scheduling may cause starvation
- III Round robin is better than FCFS in terms of response time

- (A) I only
- (B) I and III only
- (C) II and III only
- (D) I, II and III

YEAR 2010

TWO MARKS

Q. 61

The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as  $S_0 = 1, S_1 = 0, S_2 = 0$

| Process $P_0$                                                                                                                          | Process $P_1$                                                   | Process $P_2$                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|
| <pre>While (true){     wait (<math>S_0</math>);     print '0';     release (<math>S_1</math>);     release (<math>S_2</math>); }</pre> | <pre>wait (<math>S_1</math>); release (<math>S_0</math>);</pre> | <pre>wait (<math>S_2</math>); release (<math>S_0</math>);</pre> |

How many times will process  $P_0$  print '0' ?

- (A) At least twice (B) Exactly twice  
(C) Exactly thrice (D) Exactly once

Q. 62

A system has  $n$  resources  $R_0 \dots R_{n-1}$ , and  $k$  processes  $P_0 \dots P_{k-1}$ . The implementation of the resource request logic of each process  $P_i$ , is as follows:

```
if (i%2==0){
 if(i<n)request R_i ;
 if(i+2<n)request T_{i+2} ;
}
else {
 if (i<n)request R_{n-1} ;
 if (i+2<n)request R_{n-i-2} ;
}
```

In which one of the following situations is a deadlock possible ?

- (A)  $n = 40, k = 26$  (B)  $n = 21, k = 12$   
(C)  $n = 20, k = 10$  (D)  $n = 41, k = 19$

YEAR 2011

ONE MARK

Q. 63

Let the time taken to switch between user the kernel modes of execution be  $t_1$  while the time taken to switch between two processes be  $t_2$ . Which of the following is TRUE?

- (A)  $t_1 > t_2$  (B)  $t_1 = t_2$   
(C)  $t_1 < t_2$   
(D) nothing can be said about the relation between  $t_1$  and  $t_2$

Q. 64

A computer handles several interrupt sources of which the following are relevant for this question.

- \* Interrupt from CPU temperature sensor (raises interrupt if CPU temperature is too high)
- \* Interrupt from Mouse (raises interrupt if the mouse is moved or a button is pressed)
- \* Interrupt from Keyboard (raises interrupt when a key is pressed or released)
- \* Interrupt from Hard Disk (raises interrupt when a disk read is completed)



Which one of these will be handled at the HIGHEST priority?

- (A) Interrupt from Hard Disk
- (B) Interrupt from Mouse
- (C) Interrupt from Keyboard
- (D) Interrupt from CPU temperature sensor

Q. 65

A thread is usually defined as a “light weight process” because an Operating System (OS) maintains smaller data structures for a thread than for a process. In relation to this, which of the following is TRUE?

- (A) On per-thread basis, the OS maintains only CPU register state
- (B) The OS does not maintain a separate stack for each thread
- (C) On per-thread basis, the OS does not maintain virtual memory state
- (D) On per-thread basis the OS maintains only scheduling and accounting information

Q. 66

Let the page fault service time be 10 ms in a computer with average memory access time being 20 ns. If one page fault is generated for every  $10^6$  memory accesses, what is the effective access time for the memory?

- (A) 21 ns
- (B) 30 ns
- (C) 23 ns
- (D) 35 ns

YEAR 2011

TWO MARKS

Q. 67

Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

| Process | Arrival Time | Burst time |
|---------|--------------|------------|
| P0      | 0 ms         | 9 ms       |
| P1      | 1 ms         | 4 ms       |
| P2      | 2 ms         | 9 ms       |

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

- (A) 5.0 ms
- (B) 4.33 ms
- (C) 6.33 ms
- (D) 7.33 ms

Q. 68

An application loads 100 libraries at startup. Loading each library requires exactly one disk access. The seek time of the disk to a random location is given as 10 ms. Rotational speed of disk is 6000 rpm. If all 100 libraries are loaded from random locations on the disk, how long does it take to load all libraries? (The time to transfer data from the disk block once the head has been positioned at the start of the block may be neglected.)

- (A) 0.50 s
- (B) 1.50 s
- (C) 1.25 s
- (D) 1.00 s

YEAR 2012

ONE MARK

Q. 69

A process executes the code

```
fork();
fork();
fork();
```

The total number of child processes created is

- (A) 3 (B) 4  
(C) 7 (D) 8

YEAR 2012

TWO MARKS

Q. 70

Consider the 3 processes, P1, P2 and P3 shown in the table.

| Process | Arrival Time | Time Units Required |
|---------|--------------|---------------------|
| P1      | 0            | 5                   |
| P2      | 1            | 7                   |
| P3      | 3            | 4                   |

The completion order of the 3 processes under the policies FCFS and RR2 (round robin scheduling with CPU quantum of 2 time units) are

- (A) **FCFS:** P1, P2, P3 **RR2:** P1, P2, P3  
(B) **FCFS:** P1, P3, P2 **RR2:** P1, P3, P2  
(C) **FCFS:** P1, P2, P3 **RR2:** P1, P3, P2  
(D) **FCFS:** P1, P3, P2 **RR2:** P1, P2, P3

Q. 71

Fetch\_And\_Add(X, i) is an atomic Read-Modify-Write instruction that reads the value of memory location X, increments it by the value i, and returns the old value of X, it is used in the pseudocode shown below to implement a busy-wait lock. L is unsigned integer shared variable initialized to 0. The value of 0 corresponds to lock being available, while any non-zero value corresponds to the lock being not available.

```
AcquireLock (L) {
while (Fetch_And_Add([, 1))
L = i
}
ReleaseLock (L {
 L = 0;
}
```

This implementation

- (A) fails as L can overflow  
(B) fails as L can take on a non-zero value when the lock is actually available  
(C) works correctly but may starve some processes  
(D) works correctly without starvation

Q. 72

A file system with 300 GByte disk uses a file descriptor with 8 direct block addresses, 1 indirect block address and 1 doubly indirect block address. The size of each disk block is 128 Bytes and the size of each disk block address is 8 Bytes. The maximum possible file size in this file system is

- (A) 3 KBytes (B) 35 KBytes  
(C) 280 KBytes (D) dependent on the size of the disk

Q. 73

Consider the virtual page reference string

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

on a demand paged virtual memory system running on computer system that has main memory size of 3 page frames which are initially empty. Let LRU, FIFO and OPTIMAL denote the number of page faults under the corresponding page replacement policy. Then

(A)  $\text{OPTIMAL} < \text{LRU} < \text{FIFO}$

(B)  $\text{OPTIMAL} < \text{FIFO} < \text{LRU}$

(C)  $\text{OPTIMAL} = \text{LRU}$

(D)  $\text{OPTIMAL} = \text{FIFO}$

\*\*\*\*\*

© www.nodia.co.in

## ANSWER KEY

| Operating System |     |     |     |     |     |     |     |     |     |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1                | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| (A)              | (B) | (B) | (C) | (B) | (B) | (B) | (B) | (B) | (B) |
| 11               | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  |
| (A)              | (C) | (A) | (D) | (C) | (B) | (C) | (B) | (D) | (A) |
| 21               | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  |
| (A)              | (D) | (D) | (C) | (C) | (D) | (B) | (A) | (A) | (C) |
| 31               | 32  | 33  | 34  | 35  | 36  | 37  | 38  | 39  | 40  |
| (A)              | (B) | (B) | (B) | (B) | (A) | (D) | (B) | (B) | (C) |
| 41               | 42  | 43  | 44  | 45  | 46  | 47  | 48  | 49  | 50  |
| (D)              | (A) | (C) | (D) | (D) | (C) | (B) | (C) | (B) | (B) |
| 51               | 52  | 53  | 54  | 55  | 56  | 57  | 58  | 59  | 60  |
| (A)              | (B) | (A) | (B) | (C) | (A) | (B) | (A) | (A) | (D) |
| 61               | 62  | 63  | 64  | 65  | 66  | 67  | 68  | 69  | 70  |
| (A)              | (B) | (?) | (D) | (C) | (B) | (A) | (D) | (C) | (C) |
| 71               | 72  | 73  |     |     |     |     |     |     |     |
| (B)              | (B) | (B) |     |     |     |     |     |     |     |