BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
First Semester 2005-2005

Course Title : OPERATING SYSTEMS **Course No *IS C362***
Component : Comprehensive Exam ***Closed Book Component***
Weightage : 30% **Max Marks: 90** **Date: 03/05/2005**

Note: Attempt all the Questions. Start each answer from a fresh page.

Question #1 CPU scheduling (18 Marks)

In the following scenario compare results in terms of Average waiting time, Average turn around time, and CPU utilization between SJF, SRTF, Preemptive priority, and Non preemptive priority scheduling. (The lesser the priority value the more the priority)

Process	CPU Burst	T.CPU burst	Priority	Arrival Time	I/O time
P1	5	9	3	0	3
P2	7	7	2	1	0
P3	6	11	4	3	2
P4	3	7	6	6	7

Question #2 Process, Thread And Concurrency (18 Marks)
(Question #2A) (6 Marks)

Below describes Bakery algorithm. Mention a scenario where this implementation of Bakery algorithm will fail. Rewrite the Bakery algorithm to overcome this flaw.

```
Do {
        number[i] = max(number[0], number[1], …, number [n – 1])+1;
        for ( j = 0 ; j < n ; j++ )  {
                while ( number[j] != 0) &&
                        ( number [ j , j ] ) < ( number [ i , i ] ) ;
        }
                CRITICAL SECTION
        number[i] = 0 ;
           REMAINDER SECTION
} while(1) ;
```

(Question #2B) (5 Marks)

Suppose you try to implement semaphores as follows (call this version 1):

P:	V:
disable interrupts	disable interrupts
while (s <= 0)	s = s + 1
; /* do nothing */	enable interrupts
s = s – 1	
enable interrupts	

Now suppose you try to implement semaphores by replacing the "; /*do nothing */" in the definition of P with "{disable interrupts; enable interrupts}"(call this version2).

(1) What problem does version 1 have that is fixed by version 2? (2M)

(2) What problems do both of these implementations share? (3M)

(Question #2C) **(3 Marks)**

Suppose we have N processes, which use 2 critical regions, which are protected using semaphores. You can assume that the critical regions are independent of each other, the processes implement the critical region protocol correctly and that there is no starvation. What is the maximum number of suspended processes?

(Question #2D) **(4 Marks)**

Consider the interprocess-communication scheme where mailboxes are used. Suppose a process P wants to wait for two messages, one from mailbox A and one from mailbox B. What sequence of send and receive should it execute? (Remember send is not blocking but receive is blocking. Also, it should be noted that P does not know whether A will have the message before B or vice-versa)

Question #3 Memory Management (31 Marks)

(Question #3A) **(10 Marks)**

A system uses TLB (Mt), Cache (Mc), Primary memory (Mp) and Disk as the secondary memory (Ms). The time to access Mt is 5nS, time to access Mc is 5nS, time to access Mp is 70nS and the time to access and process Ms (including page in, page out and page table update) is 5mS. If a probability of TLB hit is 0.9 (Mc contain all the information what Mt points to) and residual probability of the data being in Mp is 0.95 and the residual probability of data being in Ms is 1.00. Assume that the memory hierarchy is checked in the order Mt Mp Ms, what is the expected access time for a byte instruction. (3+3+4)

(Question #3B) **(2 Marks)**

_____ and _____ kinds of pages in a process' virtual address space are usually protected as "Read Only".

(Question #3C) **(11 Marks)**

Suppose we have a computer system with a 44-bit virtual address, page size of 16K, and 4 bytes per page table entry.

1) How many pages are in the virtual address space? (2M)

2) Suppose we use N-level paging and arrange for all page tables to fit into a single page frame. How will the bits of address be divided up? (3M)

3) Suppose we have a 4 Gbyte program such that the entire program and all necessary page tables (using N-level paging as in part b) are in memory. How much memory (in page frames) is used by the program, including its page tables? (6M)

(Question #3D) **(8 Marks)**

Suppose we have an average of one page fault every 20,000,000 instructions, a normal instruction takes 2 nanoseconds, and a page fault causes the instruction to take an additional 10 milliseconds. What is the average instruction time, taking page faults into account? Redo the calculation assuming that a normal instruction takes 1 nanoseconds instead of 2 nanoseconds.

Question #4 File Systems (23 Marks)

(Question #4A) (4 Marks)

On a Unix file system, how many disk read operations are required to read the first block of the file "/home/unix/isc362/os/copre.pdf"? Assume that the master block is in memory, but nothing else. Also assume that all directories are one block in size.

(Question #4B) (10 Marks)

(2 Marks for every right answer, -1 mark for wrong answer & 0 marks if not attempting)

1. Is it possible to implement a file system inside of a file stored in another file system? (Yes / No)
2. Is it possible to have two file systems on a single physical disk drive? (Yes / No)
3. Is it possible to have a file system that spans two physical disk drives? (Yes / No)
4. Is it possible to have a file that is not in a file system? (Yes / No)
5. The mount operation allows you to graft the directory tree from one file system onto the directory tree of another file system. Does this mean that a file can span both file systems? (Yes / No)

(Question #4C) (4 Marks)

Consider a file of size 262144 bytes (2 ^18 bytes). Assume that this file is stored on a disk where the block size is 256 bytes and a block address is 16 bits. Furthermore the content of this file is such that the first logical block consists of just the character ‘a’ (256 times). The logical block in the middle of the file consists of just the character ‘b’ and the last logical block consists of character ‘c’. The rest of the data in the file is all zeros.

Suppose this file is stored using linked allocation. How many blocks on the disk will be used by this file.

(Question #4D) (5 Marks)

There exist a file named “compre.c” in prithvi server. The ls –l command gives following details about the file

- r w – r - - r - - 1 OS staff 1002 April 24 15:40 compre.c

We created the following hard link and symbolic link on May 2 10:10.

The commands we executed on May 2 are

ln compre.c hl1

ln compre.c hl2

ln –s compre.c sl1

What will be the output of the following ls commands if I am executing it after the above commands?

1. ls –l compre.c (1Mark)
2. ls –l hl2 (2Marks)
3. ls –l sl1 (2Marks)