

**Question 1:** Inter Process Communication Model [20 points]

Late-Night Pizza: A group of students are studying for a CSE521 exam. The students can study only while eating pizza. Each student executes the following loop: while (true) pick up a piece of pizza; study while eating the pizza. If a student finds that the pizza is gone, the student goes to sleep until another pizza arrives. The first student to discover that the group is out of pizza phones PizzaZone to order another pizza before going to sleep. Each pizza has S slices. Write code to synchronize the student threads and the pizza delivery thread. Your solution should phone PizzaZone (i.e., wake up the delivery thread) exactly once each time a pizza is exhausted. No piece of pizza may be consumed by more than one student. [Andrews91]

**Question 2:** CPU Scheduling [20 points]

Suppose four jobs A, B, C, and D with CPU burst times of 10, 2, 5, and 3, respectively, arrive at time = 0, 1, 3 and 4 respectively. Using a Gantt Chart, show how they are scheduled to run by the following scheduling policies. Also compute the average waiting time of the processes for the following scheduling policy.

- shortest remaining time first, preemptive.

**Question 3:** Process Description and Control: Process States [15 points]

Draw the state diagram that explains the life cycle of a process. Give an example for an event/condition that will bring about each of the transitions in the diagram.

**Question 4:** Synchronization Primitives: Semaphores [25 points]

A barrier synchronization primitive provides a rendezvous point among n threads. The barrier.h file of the nachos threads directory is enclosed. Implement a simple barrier primitive using nachos semaphores. The file barrier.h defines the method signatures for your implementation. The class consists of four items. The Barrier constructor will allow you create a barrier of a particular capacity (size). The Barrier::barrierSynch method will cause each thread invoking the barrier to block until the thread capacity is met. For example, if a barrier is created with a size of 3 elements, the first two threads that call the barrierSynch() method will block, and the third will release the first two and continue. The order for release should be the same as the order for arrival. A Barrier::print() method prints list of threads blocked within the barrier as well as the capacity information. You will also define a destructor, which will release any blocked thread back into the system. You will define the necessary private data and implement all methods.

**Question 5:** Nachos System Calls [20 points]

Consider a system call to create a "socket". Sockets are end-points for communications. The system call syntax is given below.

```
int SockID =  
    Create_Socket (char *name, char Socket_type, int domain, int protocol);
```

- a. Show all the steps in handling this call (in `exception.cc`) in the form of a mixture of code and pseudo code. In particular,
- (i) Calling conventions: How is the system call code passed in? Which registers contain what information for each parameter?
  - (ii) Parameter Translation: How are parameters for the socket call translated to system space? What translation modes are needed?
  - (iii) Return value: How is the "return status" returned to the caller?
  - (iv) Return address: What actions do you take to execute the next instruction following the system call?
- b. Assume that socket references are thread-specific resource. Each thread can have only  $N$  (say, 4) sockets available to them at any time. Where will the socket references be stored? What data structure is needed to manage the socket references? Provide the details of the data structures. Draw a figure and explain. (You can discuss the details in terms of `.h` and `.cc` files, if you prefer)

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**CSE521 Introduction to Operating Systems**  
**Fall 2003**  
**Exam 1**  
**Instructor: Bina Ramamurthy**

Time: 50 minutes

<b>Instructions:</b>	<b>Question</b>	<b>Points</b>	<b>Grade</b>
1. This exam consists of 5 questions, and 3 pages. PLEASE CHECK.	1	20	_____
2. Write your name and person number on this page NOW.	2	20	_____
3. This exam is CLOSED BOOK, CLOSED NOTES, and CLOSED NEIGHBORS.	3	15	_____
4. For full credit, show ALL of your work, not just the results.	4	25	_____
5. You are allowed only one sheet of handwritten information.	5	20	_____
6. Write your answers in the spaces provided. You may use the backs of pages if you find it necessary.			
7. Raise your hand if you have any questions.			
8. There are severe penalties for academic dishonesty.			
9. Please RETURN the ENTIRE EXAM before leaving the room.			
	Total	100	_____
	<b>LETTER GRADE _____</b>		