1. What is the difference between a multiprocessor system and a multi-computer system? (4%)

2. (a) Suppose that there is a sender buffer and a receiver buffer. Please list all possible combinations of synchronization points for sender and receiver. In addition, please also show that their associated communication is reliable or not (ignore the underlying communication protocol). (b) Suppose that there is no sender buffer but has a receiver buffer. Please list all possible combinations of synchronization points for sender and receiver and their associated communication is reliable or not. (ignore the underlying communication protocol) (8%)

3. In client-server architecture, we have vertical distributions and horizontal distributions. Please explain the meaning of vertical distribution and horizontal distribution. (4%)

4. Explain why an IDL specification can allow a client running in one platform can communicate with a server running in another platform. (4%)

5. Please describe and compare the (a) persistent communications and (b) transient communications. Please also give application examples that use persistent communications or transient communications. (4%)

6. In the message-oriented communication scheme, communication can be asynchronous or synchronous. Please explain and compare synchronous communications v.s. asynchronous communications. (4%)

7. A running process supporting code migration consists of three segments: code segment, resource segment, and execution segment. (a) Please show the content of these three segments. Furthermore, it may also contain a migration stack if migration is occurred in heterogeneous systems. (b) What is the content of the migration stack? (c) Whether the migration stack is a new data structure or it is contained in one of above three segments and, if yes, which segment? (d) Why we can achieve code migration between heterogeneous systems by using the migration stack? (e) We can only migrate a process at some specific execution points, e.g., when a next subroutine is called. Why? (10%)

8. Please describe the iterative name resolution and recursive name resolution. Please also show their advantages and disadvantages. (4%)

9. (1) What is the purpose of forwarding pointer? (2) Please describe the disadvantages of forwarding chains. (4%)

10. Indirection scheme can be used to solve the problems in weighted reference counting method. (1) Please describe what the problem is in weighted reference counting method. (2) In addition, how the indirection work to solve this problem. (4%)

11. There are some consistency models with synchronization operations. Why we use the synchronization operations in a consistency model? (5%)

12. In distributed systems, define and differentiate between sequential consistency (originally defined by Lamport, 1979) and causal consistency (originally defined by Hutto and
Ahmad, 1990). (5%)

13. Assume that there are 4 processes, numbered 1–4, and they all share a variable, named x. With regard to the operations on x, support that process 1 performs 2 writes, process 2 performs one read and one write, process 3 performs 2 reads, and process 4 performs 3 reads. Give and explain explicitly a sequence of executions which it meets causal consistency but not sequential consistency. (5%)

14. A fault tolerant system can be derived by masking failure using redundancy. (1) What is so called time redundancy? (5%) (2) Triple Modular Redundancy (TMR) is an example of physical redundancy. Describe how it works. (5%) (3) What is so called the Byzantine general problem? (2%) Propose a solution to Byzantine general problem. (5%) (4) Can the model of TMR handle Byzantine failures? Why? (5%)

15. What is the main purpose of concurrency control algorithm? (3%) What is the difference between pessimistic and optimistic concurrency control? (5%) Timestamp ordering scheme can be pessimistic or optimistic. Please describe both approaches and show their advantages and disadvantages respectively. (5%)