# THE UNIVERSITY
## *of* LIVERPOOL

# May 2004 EXAMINATIONS

Bachelor of Arts: Year 2
Bachelor of Science : Year 2

# Distributed Systems

**TIME ALLOWED : Two Hours**

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**INSTRUCTIONS TO CANDIDATES**

Answer any **four** questions only.
Each question is worth 25 marks.

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).

*Electronic calculators are neither necessary nor permitted.*

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## Question I

1. Give four examples of resources to be shared in a distributed system.  **2 marks**

2. What are the goals of a distributed system  **4 marks**

3. Explain what is meant by (distribution) transparency  **3 marks**

4. What is the role of middleware in a distributed system?  **4 marks**

5. What is the difference between a distributed operating system and a network operating system?  **3 marks**

6. What is a three-tiered client-server architecture?  **4 marks**

7. What are the most important scalability problems in Jini?  **5 marks**

## Question II

1. Is a server that maintains a TCP/IP connection to a client necessarily stateful or stateless?  **2 marks**

2. What do client and server stubs do for remote procedure call (RPC)?  **3 marks**

3. (a) What is the purpose of a registry for object-oriented remote method invocation (RMI)?  **2 marks**

   (b) If a client invokes the same remote method again, does it necessarily use the registry?  **2 marks**

4. Compare kernel threads with user threads. Give at least two advantages of kernel threads over user threads.  **4 marks**

5. Does CORBA support the thread-per-object invocation policy? Explain your reasoning.  **4 marks**

6. Is a file server implementing NFS version 3 required to be stateless? Explain your reasoning.  **4 marks**

7. What type of coordination model would you use to classify the message-queueing systems?  **4 marks**

## Question III

1. Give an example of where an address of an entity $E$ needs to be further resolved into another address to actually access $E$.  **2 marks**

2. Give two examples of identifiers (here, by the term "identifiers" we mean those identifiers that refer to entities in distributed systems).  **2 marks**

3. Is an identifier allowed to contain information on the entity it refers to?  **2 marks**

4. Explain the difference between a hard link and a soft link in UNIX systems. **4 marks**

5. Which name server addresses do DNS name servers hold by default, and why? **4 marks**

6. In a hierarchical location service with a depth of $k$, how many location records need to be updated at most when a mobile entity changes its location? **5 marks**

7. Consider two CORBA systems, each with their own naming service. Outline how the two naming services could be integrated into a single, federated naming service. **6 marks**

## Question IV

1. A clock is reading 12:45:46.0 (hr:min:sec) when it is discovered to be 5 sec fast. Are there any drawbacks in setting it back to the correct time at that point? **2 marks**

2. Suppose that two processes detect the demise of the coordinator simultaneously and both decide to hold an election using the bully algorithm. What happens? **4 marks**

3. Define the following notions:

   (a) Critical section **2 marks**

   (b) Mutual exclusion **2 marks**

   (c) Semaphore **2 marks**

4. Does NFS implement entry consistency? If so, how? **4 marks**

5. When using a lease, is it necessary that the clocks of a client and the server are tightly synchronised? Why / why not? **4 marks**

6. Explain how replication in DNS takes place, and why it actually works so well. **5 marks**

## Question V

1.
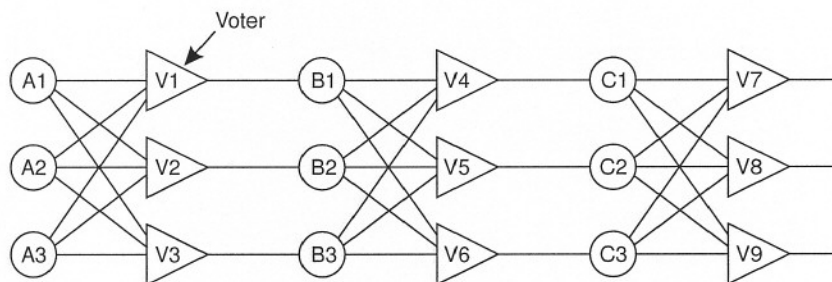


   What is the maximal number of failed devices that the circuit given above can handle? **2 marks**

2. Can the model of triple modular redundancy handle Byzantine failures? **3 marks**

3. Consider two communication services for use in asynchronous distributed systems. In service A, messages may be lost, corrupted, duplicated or delayed. In service B, messages may be lost, delayed or delivered too fast but those that are delivered arrive ordered and with the correct contents.

    (a) Describe the classes of failure exhibited by each service         **2 marks each**

    (b) Can service B be described as a reliable communication service?     **2 marks**

4. Why are public key certificates needed?         **5 marks**

5. Compare secret key encryption with public key encryption. Give two advantages of secret key over public key encryption and two advantages of public key over secret key encryption. Can a protocol use both secret and public key encryptions to have the advantages of both?     **9 marks**