# UNIVERSITY OF LONDON

## IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

## EXAMINATIONS 1998

BEng Honours Degree in Computing Part III
BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
BSc Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part III
for Internal Students of the Imperial College of Science, Technology and Medicine

*This paper is also taken for the relevant examinations for the*
*Associateship of the City and Guilds of London Institute*
*Associateship of the Royal College of Science*

PAPER 3.35 / I3.14

DISTRIBUTED SYSTEMS

Thursday, April 30th 1998, 2.30 - 4.30

*Answer THREE questions*

For admin. only: paper contains 4 questions

1 A building air-cooling system has a microcomputer for every room connected to a central operator's workstation via a network. Each room has a temperature sensor and a local control panel with a switch to enable/disable the room air-cooler, a dial to set the desired temperature, and a display to indicate the current room temperature. The current state (cooler on/off and local temperature) of every room is indicated on the operator's display. The operator can over-ride the local room controller to enable or disable it i.e. the cooler only switches on if both the local switch is *on* and the operator has *enabled* cooling for the room. The operator has a keyboard to enter room numbers and commands. Assume the room controller sends state information every 5 seconds to the operator and receives back operator settings for the room.

a Assuming a Corba-like object invocation system for implementation, produce a diagram indicating all the objects needed to model this cooling system and the operation invocations between objects (only a single room system plus operator station need be shown). Assume the room controller is passed the room number as an instantiation parameter.

b Give a *pseudocode* outline for the room controller assuming it is a client and all other objects are servers (strict Corba syntax is not required).

*The two parts carry, respectively, 50%, 50% of the marks.*

2 A spooler object can spool up to N files and provides the following methods:

```
void put (File f)
    // put File f in spool queue if less than N files in queue
    // otherwise client call blocked until less than N files in queue

File get ( )
    // called by remote printer driver process to get a file from the queue
    //  the call blocks if the queue is empty
```

a Give a *pseudocode* outline of the spooler using a guarded selective receive statement to accept calls.

b Assuming a multi-threaded server and using any suitable synchronisation mechanism such as semaphores, give a *pseudocode* outline of the spooler for a Corba server.

c Briefly, discuss the differences between the two approaches in (a) and (b).

*The three parts carry, respectively, 40%, 40%, 20% of the marks.*

3a Briefly describe, with the aid of a diagram, the format of an hierarchical X.500 Directory Service distinguished name and indicate how to make sure a name is unique when assigning it.

b Compare a Management Domain with a distributed file system directory. How can a domain be used to represent the rights of a person within the system?

c What is a management role and why is needed? With an aid of a diagram, briefly explain how it can it be implemented using domains and policies?

*The three parts carry, respectively, 35%, 25%, 40% of the marks.*

4 A stockbroker accepts instructions via email, but insists all messages are sent via a notarisation service trusted by the firm's client and by the stockbroker. The following protocol is used for message exchange between the client (C), notary (N) and stockbroker (S).

i) C to N: C, Kcs{i}, Kcn{C, S, Tc, H(Kcs{i}) }

ii) N to S: N, Ksn {C, Tc,Tn}, Kcs{i}, Kcn{C, Tc, Tn, H(Kcs{i}) }

i is the instructions from client to stockbroker,
Kxy is a secret encryption key known only to X and Y,
H(z) is a hash digest over a file z,
Tx is a timestamp generated by X.

a Explain how the above protocol works, justifying the fields in each message and why fields are encrypted with particular keys.

b Assume the notary provides no long-term storage. Explain how the notary can be used by the stockbroker to prove that the client did send a particular message.

*The two parts carry, respectively, 65%, 35% of the marks.*

*End of paper*