IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2014

BEng Honours Degree in Electronic and Information Engineering Part II
MEng Honours Degree in Electronic and Information Engineering Part II
BSc Honours Degree in Mathematics and Computer Science Part III
MSc in Computing Science
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

PAPER C527

COMPUTER NETWORKS AND DISTRIBUTED SYSTEMS

Tuesday 29 April 2014, 14:30
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators required

Section A (Use a separate answer book for this section.)

1 a Briefly explain each of the following terms and state which layer of the OSI reference model the term relates to:

i) ICMP

ii) Frame delimiter

iii) SMTP

iv) Routing table

b A new LAN technology permits communication at 100 Gbps across a maximum distance of 10 km (without repeaters). It uses copper cabling, in which signals propagate at a rate of 200,000 km/s.

i) Explain the purpose of *medium access control* (MAC) in networks.

ii) Briefly describe, with the help of a diagram, the operation of CSMA/CD.

iii) With the help of a calculation, discuss whether CSMA/CD would be effective.

iv) Describe how the LAN technology above could interconnect more than two hosts.

The two parts carry, respectively, 40% and 60% of the marks.

2a Networks can be classified as *circuit switched* (CS) or *packet switched* (PS).

i) Describe **three** differences between CS and PS.

ii) Which one would be more suited for live streaming of video and why?

iii) Indicate how they relate to *connectionless* and *connection-oriented* communication services.

iv) Would it be possible to provide a *connectionless* communication service on a CS network? If so, describe how such a network would work; if not, explain why it is not possible.

b The bit string 10101110 needs to be transmitted at the data link layer.

i) Draw three figures, annotated with the boundaries between bits, showing its encoding using the following schemes:

A) TTL line encoding

B) Manchester encoding

C) Differential Manchester encoding

ii) Explain which features of an encoding scheme are most important for a channel operating at 100 Gbps.

iii) Based on your answer under ii), design an encoding scheme that would be most appropriate for a channel operating at 100 Gbps.

The two parts carry, respectively, 45% and 55% of the marks.

Section B (Use a separate answer book for this Section)

3 A trading system consists of a *terminal*, connected to a *share monitoring agent (SMA)* running on a network server. The *terminal* is implemented by a Java RMI server which supports adapter objects for the trader's display and keyboard. The SMA monitors the shares' value by polling a *Quote Server* every 5 seconds. It sells the shares through a *stockbroker* when their value falls below a *stop-loss value*. For simplicity, assume the shares of a single company are monitored; the *SMA* is initialised with the *name*, *number of shares* and their *stop-loss value*. Before selling, the *SMA* must display an alert on the trader's *display* and request confirmation from the trader's *keyboard*. After selling, the *SMA* must display the value at which they have been sold on the screen. Quotes obtained from the *Quote Server* contain the *share name*, *opening value* and the *current value*.

Consider the interfaces given below. The 5 second delay can be implemented using `Thread.sleep (millseconds)`.

```
class Quote implements java.io.Serializable
  { String shareName; float open; float current; }

interface iKeyboard extends Remote {
  public boolean confirmSale(String name, long quantity) throws RemoteException;}

interface iDisplay extends Remote {
  public void display(String shareName, float current, float open, float change)
    throws RemoteException;
  public void alarm(String shareName) throws RemoteException;
  public void sold(String shareName, float value) throws RemoteException;}

interface iStockbroker extends Remote {
  public float sell(String shareName, long quantity) throws RemoteException;}

interface iQuoteServer extends Remote {
  public Quote getQuote(String sharename) throws RemoteException;}
```

a Assuming a Java RMI invocation system for implementation, produce a diagram indicating the objects needed and the *invocations* between objects.

b Give the Java implementation for the *SMA*.

c Give the Java implementation for the *terminal server*, which implements the *keyboard* and *display* remote objects.

Implementations for the *StockBroker* and *QuoteServer* remote objects are not needed; assume they have been created. Strict Java syntax is not required but

your solution should indicate what is needed for instantiating remote objects, remote reference registration, binding and security etc.

The three parts carry, respectively, 15%, 40%, and 45% of the marks.

4 a Explain what is meant by a *mandatory*, *discretionary* and *non-discretionary (policy)* access control model, giving examples of each.

b The FTP protocol can operate in passive mode in which the control connection is established in the same way as for normal FTP but the data connection is established differently. Instead of informing the server of the port allocated for the data connection the client notifies the server that it wishes to use passive mode. The server then dynamically allocates a port of its own in the application port range and informs the client of the port number. A TCP data connection is then opened by the client from its dynamically created data port to the server's data port.

i) Discuss the advantages and disadvantages of the passive mode of operation over the normal mode and identify the situations in which it should be used.

ii) A packet filtering router separates an internal network (denoted *IntNet*) from the outside network (denoted *OutNet*). Give the rules necessary to configure the packet filtering router to allow internal clients to access outside FTP servers in passive mode, and to provide access to outside clients to an internal FTP server (denoted host1) also in passive mode. The rules should be given in the format below and you should explain what each rule achieves. Assume the direction can be *in*, *out* or *any* (both directions) where *in* denotes incoming external traffic.

Rule No.	Protocol	Dir.	Source Address	Src. Port	Dest. Address	Dest. Port	TCP Flags	Action

The two parts carry, respectively, 30%, and 70% of the marks.