UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1998

MSc Degree 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 Diploma of Membership of Imperial College

PAPER M2.10

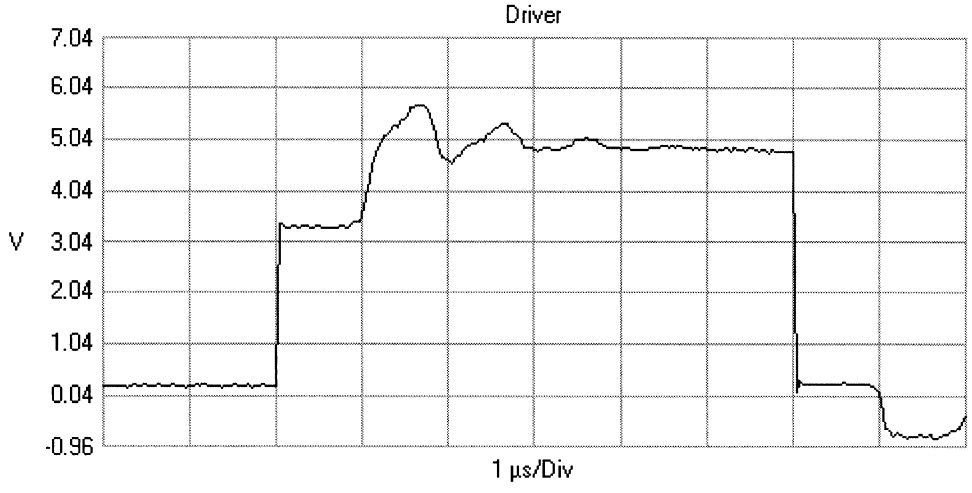
NETWORKS AND COMMUNICATIONS
Friday, May 8th 1998, 2.00 - 4.00

Answer THREE questions

For admin. only: paper contains 4 questions

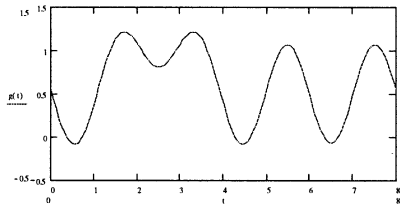
1a Describe two methods of Media Access Control.

b Since the refurbishment of the Huxley building I have noticed a deterioration in the performance of the UTP connection to my office. I have used a digital scope meter and a pulse generator to test the line. The waveform, measured at the driver, looked like this

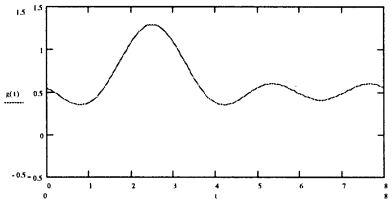


Explain why this plot helps me determine what has happened to the cable and where the fault lies. You may assume that the propagation speed of the signal in the cable is $2x10^8$ ms^{-1}.

c Having fixed the problem with my UTP connection I have gone on to determine the maximum bit rate I can reliably use. Transmitting the pattern 01110101 at a bit rate of 3000 bits per second generates the following pattern at the receiver



Doubling the speed to 6000 bps generates this



What is happening here? What additional information would you require to calculate the bandwidth of this channel?

d Draw a constellation diagram for a differential phase shift keying modem that provides a bit rate of 2 times the baud rate of a channel. What features of the diagram help to reduce the probability of errors?

The three parts carry, respectively, 25%, 30%, 30%, 15% of the marks.

2 a Sketch the seven layers of the OSI reference model, clearly showing how processes inter communicate. Give a brief description of the aspects of communication covered by each layer.

b i) How does a router differ from a bridge? Your answer should state the layers of the OSI reference model at which each operates.

ii) When might one use a bridge and when a router?

c i) Describe both a non-adaptive *and* an adaptive routing protocol with which you are familiar.

ii) If virtually all packet-switching networks use some form of adaptive routing strategy, when will a non-adaptive one still be needed?

The three parts carry, respectively, 35%, 30%, 35% of the marks.

3 a i) What is meant by the term "data transparency"?

ii) Give an example of a bit-oriented and a character-oriented Data Link layer protocol and describe how data transparency is achieved in each.

b i) The following message has just been received by you

`011000100111`

The transmitter uses a Hamming code to provide single bit error detection and allow you to perform single bit error correction. Check this message, if necessary correct it and then extract the original data.

ii) With what Code Efficiency was this message sent?

c Cyclic Redundancy Checks enable a receiver to detect burst errors in addition to single and double bit errors.

i) What is the definition of an 'n'-bit burst error?

ii) What feature of the CRC generator polynomial ensures that all single bit errors are caught? What feature ensures that all double bit errors are caught?

iii) Given an R bit generator polynomial, what is the probability of accepting a burst error less than or equal to R bits? What is the probability of accepting a burst error exactly equal to R+1 bits?

iv) Add the appropriate CRC to the following bit pattern using the generator polynomial $x^3 + x^2 + x^0$

`1110011`

The three parts carry, respectively, 35%, 30%, 35% of the marks.

Turn Over...

4 a The network level can establish either a connection oriented or a connectionless route between a source and a destination. What are the essential differences between these two types of connection? What advantages and disadvantages does each have?

b According to RFC 1180, TCP offers a connection-oriented byte stream, instead of the connectionless datagram delivery service provided by UDP. Explain the differences between the two services and their implications.

c You are designing your own network application.

i) Under what circumstances might you use TCP?

ii) Under what circumstances might you use UDP?

The three parts carry, respectively, 30%, 40%, 30% of the marks.

End of Paper