# 2910222 Data communications and enterprise networking

## Examination paper: Zone B

Time allowed: three hours

This paper is in two parts, Part A and Part B. There are a total of three questions in each part. **You should answer two questions from Part A and two questions from Part B.**

Full marks will be awarded for complete answers to a total of four questions, two from Part A and two from Part B. Each question carries 25 marks. The marks for each part of a question are indicated at the end of the part in [ ] brackets.

There are 100 marks on the paper.

No calculators may be used.

# PART A

**Question 1**

(a) State, in your answer book, which two of the following statements are true and which two are false and, if false, write out a correct version of the statement:

i. Noise is always present in any channel and will limit the capacity of the channel to carry data.
ii. Scattered waves rely on reflections from the Ionosphere.
iii. Monomode fibre allows light to follow many different paths down the fibre.
iv. Asymmetric Digital Subscriber Line uses a Discrete Multi-Tone which is a form of Frequency Division Multiplexing. [3]

(b) Write down the equations expressing Shannon's Law and Nyquist's Theorem and define all the symbols you have used. Identify the differences between the two equations and indicate the circumstances in which each should be applied. [4]

An MPEG1 compressed video signal is coded into a data stream at 1.6 Mbit/s. What bandwidth would be required to transmit this signal if 16 signaling states were used? [3]

(c) Calculate the CRC-3 code generated for the 5-bit code 11010 using the generator 1001. Show how an error would be detected if the fourth bit from the left in the 5-bit code above was corrupted. [4]

(d) Explain why it is necessary to have a pad field in the Ethernet frame structure. [4]

(e) Show how the byte 11101011 can be encoded using an even Hamming Code. Another even Hamming coded byte was received with one bit corrupted and the bits received were 101101100101. Show how the error can be detected and then corrected. What was the original byte transmitted? [7]

**Question 2**

(a) State, in your answer book, which two of the following statements are true and which two are false and, if false, write out a correct version of the statement:

i. The Type of Service field in the IP header has been redefined to support Integrated Services.
ii. ICMP is a network layer protocol which is encapsulated in IP.
iii. A TCP connection is uniquely identified by a combination of the source and destination port numbers.
iv. The UDP header checksum also protects part of the IP header. [3]

(b) Explain why classful addressing on the Internet has been abandoned and how routers now determine which part of the IP address is the network ID and which part is the host ID. [6]

(c) Describe how TCP will discover that a data segment has been lost and how it will recover from the loss. [4]

(d) Outline three advantages that IP Version 6 has over IP Version 4. [6]

(e) Show how the 16-bit Internet checksum calculation would be used to generate a checksum for the three bytes of data given below and also show how the receiver would check the data with the checksum.

01001101
01011011
10010010 [6]

**Question 3**

(a) State, in your answer book, which two of the following statements are true and which two are false and, if false, write out a correct version of the statement:

i. IGMP is an application layer protocol that is used to manage multicast groups on the Internet.

ii. SMTP is used by mail clients to retrieve emails from a server, but it does not allow just the mail headers to be retrieved. To do this users should configure their mail clients to use the IMAP protocol.

iii. The Physical Layer in the OSI Reference Model is concerned with the transport of bits through a physical medium.

iv. Many people unconsciously use FTP, because it is often used by software that uploads web pages. [3]

(b) Describe, with examples of domains at each level, the hierarchical structure of the servers in the Domain Name System going down as far as fourth level domains. [5]

(c) Produce a table that shows the mapping between the layers of the ISO OSI reference model, the DoD (or TCP/IP) Reference Model and the hybrid reference model. [6]

(d) What does the acronym MIME stand for and what is its main function? Explain why it is essential for mail clients to support this protocol. [4]

(e) Use the Huffman Code defined in the table below to compress the word "MAIL". [1]

Using the same Huffman code, draw the Huffman Tree and use it to decode the sequence of letters represented by 000110101011110110. [6]

| | | | |
|---|---|---|---|
| A | 0000 | N | 0110 |
| C | 1101 | O | 0100 |
| E | 100 | P | 10110 |
| G | 10101 | R | 0111 |
| I | 0001 | S | 0011 |
| L | 00101 | T | 111 |
| M | 10100 | U | 10111 |

# PART B

**Question 4**

(a) State, in your answer book, which two of the following statements are true and which two are false and, if false, write out a correct version of the statement:

i. An Ethernet hub broadcast a frame on all of its ports apart from the port on which the frame was received.
ii. IEEE 802.11b (otherwise known as Wi-Fi) uses the CSMA/CD access method.
iii. Fibre Channel uses World Wide Names as port addresses.
iv. Selling a new product into a new market is called market development. [3]

(b) Describe the main difference between Ethernet II and IEEE 802.3 and how each de-multiplexes to the correct network layer protocol (giving the names of any other data link protocols that need to be used). [6]

(c) A type of Ethernet is described as 10GBase-T. What does each part of this designation describe? [3]

(d) What are the main differences between a hubbed and a switched Ethernet? How else might the two types of Ethernet be described? [6]

(e) Complete the 14 blank cells of the table below in your answer book. It is part of a subnetwork addressing scheme for an IP network with the network address 193.9.18.0/23, supporting up to 4 subnetworks of up to 62 hosts, up to 6 subnetworks of up to 30 hosts and up to 16 point-to-point WAN circuits. The boundaries between the network part of the address and the subnetwork part of the address and between the subnetwork part of the address and the host part of the address are shown as vertical bars (|).

[7]

| Subnetwork | 3rd Byte | 4th Byte | Subnetwork Address | First Host Address | Last Host Address |
|---|---|---|---|---|---|
| LAN A | 00010010 | 00\|XXXXXX | 193.9.18.0/26 | 193.9.18.1 | 193.9.18.62 |
| LAN B | 00010010 | | 193.9.18.64/26 | 193.9.18.65 | 193.9.18.126 |
| LAN C | 00010010 | | | | |
| LAN D | 00010010 | | | | |
| LAN E | | 000\|XXXXX | 193.9.19.0/27 | 193.9.19.1 | 193.9.19.30 |
| LAN F | 00010011 | 001\|XXXXX | | | |
| LAN G | 00010011 | 010\|XXXXX | 193.9.19.64/27 | 193.9.19.65 | 193.9.19.94 |
| LAN H | 00010011 | 011\|XXXXX | 193.9.19.96/27 | 193.9.19.97 | 193.9.19.126 |
| LAN I | 00010011 | 100\|XXXXX | 193.9.19.128/27 | 193.9.19.129 | 193.9.19.158 |
| LAN J | 00010011 | 101\|XXXXX | 193.9.19.160/27 | 193.9.19.161 | 193.9.19.190 |
| Cct 1 | 00010011 | 110000\|XX | | 193.9.19.193 | 193.9.19.194 |
| ... | ... | ... | ... | ... | ... |

**Question 5**

(a) State, in your answer book, which two of the following statements are true and which two are false and, if false, write out a correct version of the statement:

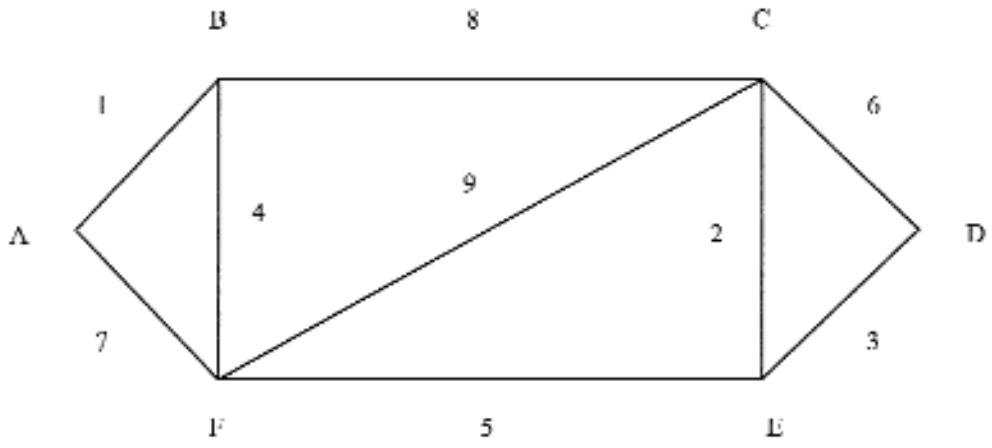
i. Switched Multi-megabit Data Service provides a connectionless network service.
ii. GSM uses a combination of frequency and code division multiplexing.
iii. The PSTN limits the bandwidth on each phone call to 3.1 kHz.
iv. Basic Rate ISDN in Europe is also known as 30B+D. [3]

(b) Describe how adaptive playout delay can be used to smooth out variations in delay when playing real-time audio or video. [5]

(c) Distinguish between repeaters, bridges and routers with regard to whether or not they separate collision domains and broadcast domains. [3]

(d) Define the characteristics of the Constant Bit Rate, Unspecified Bit Rate and Available Bit Rate ATM service categories in terms of data rate (fixed or variable), loss (low, arbitrary or fair), delay (low, arbitrary or fair) and jitter (low, arbitrary or fair). [6]

(e) Copy the following diagram into your answer book and use Dijkstra's algorithm to calculate and mark the shortest route between A and D in the diagram below (showing all the labels produced by executing the algorithm), where the numbers represent distances between the nodes. [8]



**Question 6**

(a) State, in your answer book, which two of the following statements are true and which two are false and, if false, write out a correct version of the statement:

i. Bridges are difficult to install, as they require considerable manual configuration.
ii. Point-to-Point circuits are normally given /30 subnetwork addresses.
iii. A breakout box is a portable piece of test equipment that can be used to view the state of each pin on an interface.
iv. An Intruder Detection System uses infrared sensors to detect the presence of unauthorised people in a network management centre.

[3]

(b) Briefly describe the four main types of requirements that should be included in a requirements analysis. [4]

(c) List four specific performance measurements, together with the normal way in which the measurement is expressed, that might be specified to evaluate how well a design meets user requirements. [4]

(d) Compare the advantages and disadvantages of a full-mesh WAN design with a partial-mesh WAN design. [6]

(e) What is meant by percentage availability, and how is it related to Mean Time Between Failure and Mean Time To Repair? [2]

A host computer is connected to a LAN which has an availability of 99.99%, and then over separately routed dual access circuits (each with an availability of 99.8% including routers) to a IP VPN, with an availability of 99.9%, to another host directly connected to the IP VPN via a single access circuit also with an availability of 99.8% including routers. Calculate the overall availability of the dual access circuits to the IP VPN and hence derive an expression for the overall availability of the communications between the two hosts. [6]