2910222 Data communications and enterprise networking

Examination paper: Zone A

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. Round Trip Time is the sum of the network delay on the outward path and the network delay on the inward path.

ii. At higher frequencies, radio waves travel in straight lines like light, and line of sight between the transmitter and receiver is required for successful communication.

iii. With fibre optics, there are normally two signal states corresponding to whether light is being transmitted or not.

iv. Asymmetric Digital Subscriber Lines support the same upstream and downstream speeds. [3]

(b) Identify all the differences in the equations expressing Shannon's Law and Nyquist's Theorem and indicate the circumstances in which each should be applied. [4]

A channel that provides a bandwidth of 3 kHz has a Signal to Noise Ratio of 40dB. Derive an expression for the maximum capacity of the channel and hence derive an expression for the time it would take to transmit 10 Kbytes of data through the channel (assuming there was no protocol overhead). [4]

(c) Provide three reasons why TCP/IP protocols use the Internet checksum rather than Cyclic Redundancy Checks. [3]

(d) Explain why a transparency problem exists in data link protocols and give the names and brief descriptions of two techniques that are used in data link protocols to overcome the problem. [4]

(e) Binary Coded Decimal is a code, which represents a decimal digit as a 4-bit binary numeral. (E.g. 2 is encoded as 0010 and 9 as 1001).

Show how the BCD code for the decimal digit 3 could be further coded to allow a single bit error to be corrected using an even Hamming Code. [3]

A different even Hamming Coded BCD digit was received as 1010100 with one bit in error. Show how the error can be detected and corrected. What decimal digit was originally encoded? [4]

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. TTL stands for Time to Live and indicates the number of milliseconds before the packet will be discarded.

ii. The IPv4 header contains a Next Header field which indicates the type of the next header.

iii. UDP and TCP share the same 16 bit port addressing scheme.

iv. TCP does not use negative acknowledgements. It relies on the transmitter to retransmit following a time out. [3]

(b) Explain why it is that IPv4 addresses are in short supply when the total number of IP addresses is still considerably more than the number of hosts that have been allocated addresses. [6]

(c) Describe how IP fragments and reassembles datagrams. [4]

(d) Outline the main differences between TCP and UDP and the types of application that they best support. [6]

(e) Explain how a router would use the ARP protocol to forward a packet to the correct device on a LAN when it does not known the MAC address of the device. [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. TFTP uses a Go Back N ARQ error correction technique.
ii. Protocol Data Units are exchanged between peer entities at the same layer.
iii. The Network File System uses remote procedure calls to access files on a remote system.
iv. Simple Mail Transfer Protocol is used by mail clients to send and receive messages. [3]

(b) Describe how the Domain Name System can be used to resolve a host name into an IP address. [6]

(c) Explain why application designers might choose to use an unreliable transport service. [4]

(d) Describe the limitations of the Telnet protocol for remote terminal access to hosts which might make network managers reluctant to support it and describe some ways that the limitations might be overcome. [6]

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

Using the same Huffman code, draw the Huffman Tree and use it to decode the sequence of letters represented by 0111111001110110. [5]

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:

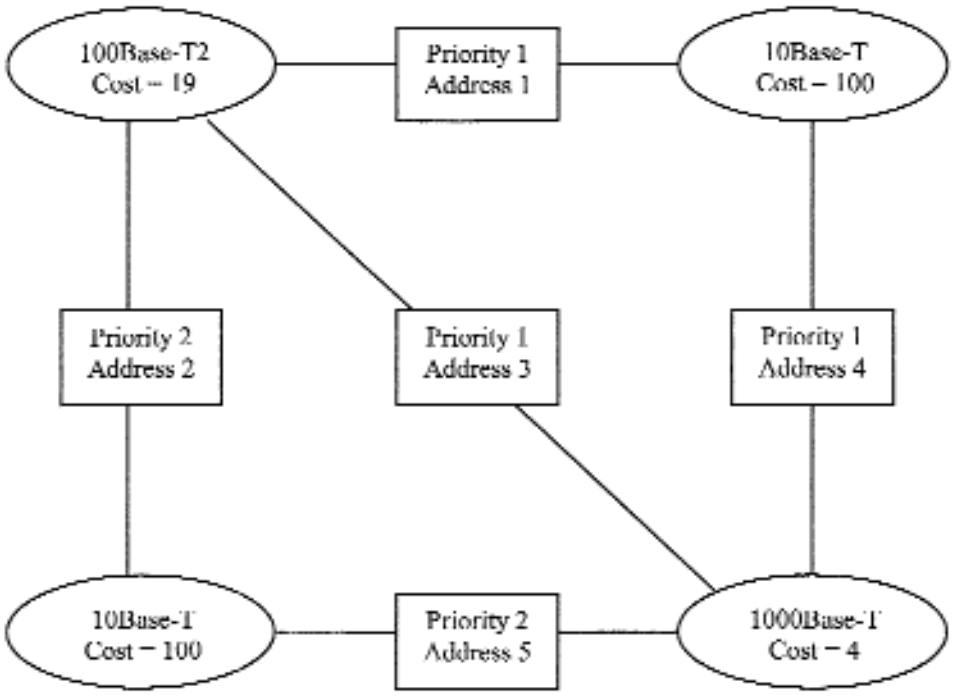
i. Bluetooth causes interference to IEEE802.11b LANs, as they use the same frequency range.
ii. Gigabit Ethernets do not suffer from collisions as they always operate in full duplex mode.
iii. Fibre Channel uses 48-bit IEEE MAC addresses.
iv. A low growth product with a high market share is called a Star. [3]

(b) Describe how a switched Ethernet differs from a hubbed Ethernet in both its operation and performance. [6]

(c) The original DIX Ethernet is described as 10Base5. What does each part of this designation describe? [3]

(d) Describe the advantages of implementing Virtual LANs. [6]

(e) Copy the following diagram into your answer book and use the Spanning Tree Protocol to determine which bridge ports should be blocked in the following LAN topology. Show which bridge is elected as the root bridge by means of a thick lined box and show the path costs from each bridge port to the root bridge. Mark all the root ports with an R, all the designated ports with a D and all the blocked ports with an X. Draw the spanning tree with thick lines on the diagram. [7]



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:

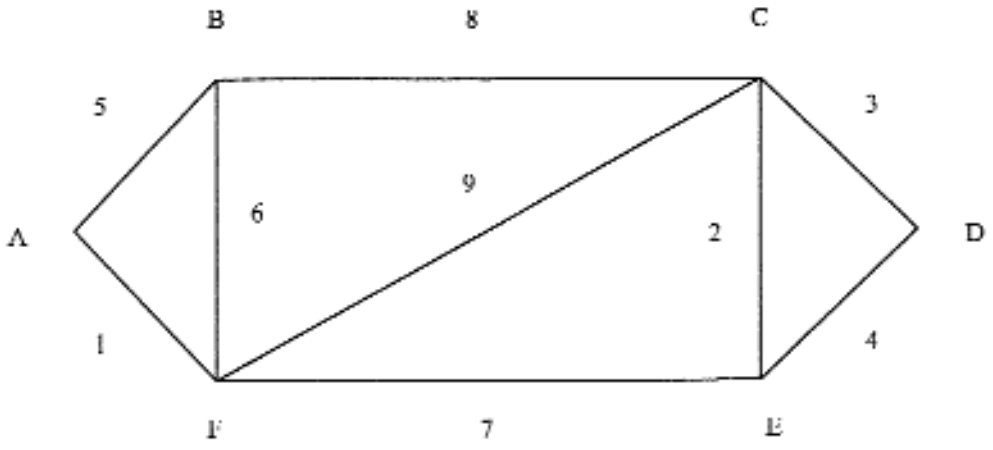
i. WAP can be used to access any web page on the Internet.
ii. VSAT networks require a double hop to be made to a satellite, thus the RTT is double that of conventional satellite networks.
iii. Private circuits carrying data over PDH transmission networks suffer occasional frame slips when synchronisation is lost.
iv. Basic Rate ISDN uses the S channel for signalling. [3]

(b) Describe how a transparent bridge learns how to bridge frames between two LANs to which it is connected, after it is switched on. [5]

(c) Describe how a distance vector routing protocol works. [4]

(d) Describe the circumstances, with examples, in which satellite communications might provide an effective communications solution. Identify some of the disadvantages of such a solution. [5]

(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. The Routing Information Protocol is a link state routing protocol which uses hop count as its metric.
ii. Class D IP addresses are used to identify multicast groups.
iii. With Ethernet, there is no upper limit to the time it can take to transmit a frame.
iv. ISDN is ideal for applications where a master device polls a remote slave device once a second. [3]

(b) Briefly describe the type of applications that are best suited to frame relay networks. [4]

(c) Identify three situations in which a wireless LAN might provide the best solution for a network within a building. [6]

(d) 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]

(e) What is meant by percentage availability and how is it related to MTBF and MTTR? [2]

A LAN has two identical routers with availabilities of 99.9% directly attached, which are each connected via separately routed circuits each with an availability of 99.8% to another pair of identical routers with an availability of 99.9% on a different LAN. Write down an expression for the overall unavailability of the communications service that is provided between the two LANs and hence calculate the overall availability of the communications service between the two LANs. [6]