

CS-M28  
PRINCIPLES AND PRACTICE OF NETWORK COMMUNICATIONS

*Attempt 2 questions out of 3*

**Question 1**

- (a) (i) Compare and contrast the 802.11a, 802.11b, and 802.11g protocols in terms of their maximum transmission speeds and positions in the frequency spectrum.
- (ii) What are the nine services (distribution and station services) which must be provided by any 802.11 LAN?
- (iii) In an 802.11 LAN utilising the *Distributed Co-ordination Function* (DCF) mode of operation, how do stations use the MACAW protocol to avoid transmitting while another station is transmitting data?

[8 marks]

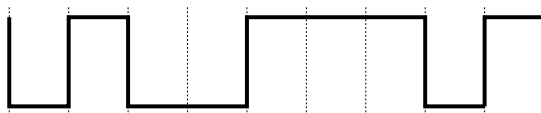
- (b) Assume the data bits 10101011 are to be transmitted. Create the total transmitted codeword if the Hamming single bit code is used for error detection, counting the bits from left to right. Assume that the penultimate bit (i.e., second from right) was inverted during the data transmission. Show step by step how the Hamming Single Bit Code can be used to detect and correct the transmission error.

[6 marks]

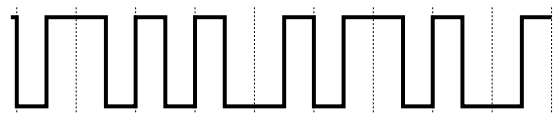
- (c) Describe the basic functions of the transport layer in the context of the OSI Reference Model. Explain why the transport layer and the upper three layers are called true **end-to-end** layers, whereas the lower three layers are called **chained** layers.
- There are four generic service primitives for the transport layer service. One of them is known as 'Request'. Name the other three.

[7 marks]

- (d) The *non-return-to-zero level* (NRZ-L) scheme encodes 0 with a high signal level and 1 with a low signal level. The *differential Manchester encoding scheme* always encodes a transition in the middle of an interval. In addition, it encodes 0 with a transition at the beginning of an interval, and 1 without such a transition. Determine the original bit streams encoded by the two signals below.



NRZ-L



Differential Manchester

[4 marks]

## Question 2

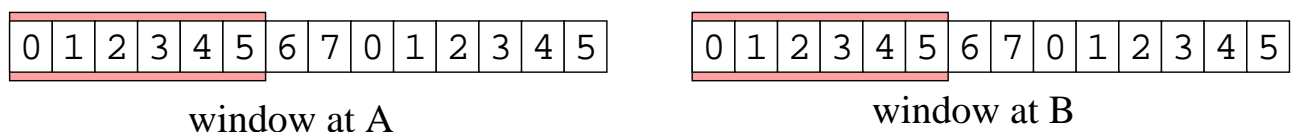
- (a) (i) Explain which is meant by an Isolated Routing technique.  
(ii) Name and describe two Isolated Routing techniques, and discuss their advantages and disadvantages, giving one advantage and one disadvantage for each technique.

[5 marks]

- (b) (i) What are the three types of node which may exist in a Bluetooth piconet?  
(ii) What is the purpose of the Baseband Layer in the Bluetooth protocol hierarchy?  
(iii) A Bluetooth frame consists of a 72 bit Access Code, a 54 bit Header, and a Data field of up to 2744 bits. What is the structure of the 54-bit Header?  
(iv) Discuss the interoperation (or otherwise) of Bluetooth and 802.11 wireless networks.

[8 marks]

- (c) Consider two DTEs, A and B, communicating using a sliding window protocol. It assumes the use of a 3-bit frame sequence number and a maximum window size of 6. Given initial window positions of A and B as shown below:



show both window positions after events at times T2, T4 and T6 respectively:

Time	DTE A	DTE B
T1	A transmits frame 0	No event
T2	A transmits frame 1	B receives frame 0
T3	A transmits frame 2	B sends acknowledge expecting frame 1
T4	A receives acknowledge expecting frame 1	No event
T5	A transmits frame 3	B receives frame 1
T6	A transmits frame 4	B receives frame 2

[6 marks]

- (d) The RSA (MIT) public key encryption method is used with the following parameters:

$$p = 7,$$

$$q = 7,$$

$$n = p * q = 49,$$

$$z = (p - 1) * (q - 1) = 36$$

- (i) If the private key **d** is of value 7, what would be the public key **e**?  
(ii) Find another pair of (different) keys neither of which is of value 3.  
(iii) Briefly explain how to provide authentication with public key encryption.

[6 marks]

### Question 3

- (a) Draw a Huffman tree which can efficiently represent the following string:

CABAEACABCDEAEFFCEFF

Use a 1 for a left-transition and a 0 for a right-transition. Show the binary code for each letter (you do not need to show the resulting binary string). Assuming that the original string was represented as ASCII (7 bits per letter), what compression ratio would you have achieved? (There is no need to reduce the fraction).

**[12 marks]**

- (b) ADSL is a popular choice for providing broadband network services to households and small businesses. Give one reason why this is the case from the point of view of each of the following:
- The telecommunication company (telco);
  - the consumer.

Give two disadvantages of the system from the telco's point of view.

Explain how ADSL is able to offer speeds of the order of 1Mbps over telephone lines which have previously only been usable at 56kbps.

What is the difference between ADSL and SDSL, in terms of the distribution of channels within the total available bandwidth?

**[5 marks]**

- (c) State whether each of the following networks is capable of providing a transmission channel with guaranteed minimal speed. Explain your answers.
- (i) a CSMA/CD network;
  - (ii) a Token Ring network;
  - (iii) an X.25 network;
  - (iv) an ATM network.

**[8 marks]**