

UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

SUPPLEMENTARY EXAMINATION 2005

TITLE OF PAPER: DATA NETWORK AND CODING THEORY (I)

COURSE NUMBER: CS440 (I)

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER ANY FOUR QUESTIONS.

EACH QUESTION CARRIES 25 MARKS.

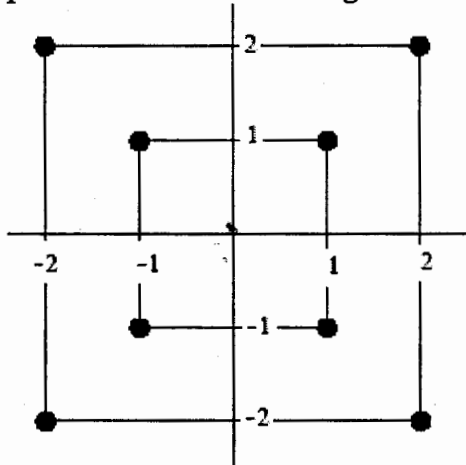
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QUESTION 1

- a) What differentiates LANs, MANs and WANs? [5]
- b) Describe Frequency Division Multiplexing and Time Division Multiplexing, indicating what type of signals use each type of multiplexing. [8]
- c) Given the binary information **11110101000111**, show how it can be transmitted over an analogue transmission medium using
 (i) Amplitude
 (ii) Phase shift modulation. [6]
- e) A person on a bicycle travelling at 50 Km/hr can carry 5 CDs, each CD containing **650 MB** ($1\text{MB} = 2^{20}$ bytes) of data. For what range of distances would it be faster to use the person on the bicycle to transfer the information on 5 CDs, than to use a **2 Mbps** ($1\text{Mbps} = 10^6$ bps) data line to transfer the data? [6]

QUESTION 2

- a) Using phase shift modulation, show how **3 bits** per baud can be transmitted. [4]
- b) Given the constellation diagram below, how many different amplitudes and phase shifts does the diagram have?



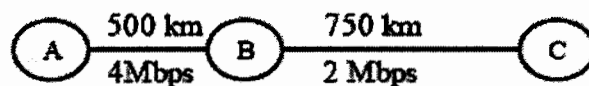
- d) How many bits are transmitted per baud? [5]
- e) In pulse code modulation, what is the sampling rate, and why this rate? [3]
- f) State two situations where optic fibre cabling would be preferable to copper cabling? [5]
- [4]

g) The bit interval is the time required to send one single bit. The bit rate is the number of bit intervals per second. If a digital signal has a bit rate of 19200 bps, what is the duration of each bit?

[4]

QUESTION 3

a) A message of **1500 bytes** is being sent using packet switching from node A to node C, via node B, as shown by the diagram below. Determine the time between the first bit leaving node A and the last bit reaching node C. Ignore the processing delay at each node. The propagation speed for the links connecting any two nodes is 2.5×10^8 m/s.



[6]

b) A certain transmission channel allows for frequencies between 3.175 GHz and 4.125 GHz and has a signal to noise ratio of 24dB. What is the channel's capacity?

[4]

c) A digital signal has a bit interval of 10 micro seconds. What is the bit rate?

[3]

d) What is the difference between bit rate and baud rate?

[3]

e) An analogue signal carries four bits in each signal element. If 2500 signal elements are sent per second, what is the baud rate and the bit rate?

[5]

f) Describe Pulse Code Modulation. Why is it necessary in telecommunication networks?

[4]

QUESTION 4

a) Data is to be transmitted over a standard telephone line using a modem at a speed of 56Kbps. Assuming the line has a usable bandwidth of 3.5 KHz, what is the minimum signal to noise ratio in dB required to support this?

[5]

b) With the assistance of an example, describe how character stuffing works.

[4]

c) What is Hamming Distance? Find the Hamming Distance for the codewords **10010101**, **00000000**, **10111001**, **10000001**.

[5]

d) Determine the transmitted codeword for the message word given by the polynomial $x^7 + x^4 + x^3 + x$, using the generator polynomial $x^3 + 1$.

[5]

- e) Show the encoded signal if the bit stream 1100111010010110 is encoded using
(i) Manchester encoding
(ii) MLT-3 encoding.

[6]

QUESTION 5

- a) Describe the operation of the CSMA/CD medium access control (MAC) protocol.

[5]

- b) Ethernet supports broadcast, unicast and multicast transmission modes. Explain what is meant by each term, and provide examples of MAC addresses of each type.

[6]

- c) The Hamming Code computes the codeword that uses the least number of check bits to correct single bit errors. Give the formula that gives the relation between the number of check bits used for a given data word. Find the Hamming Code for the bit string **10100**. Odd parity is used for the check bits.

[5]

- d) Draw the diagram of a PPP frame showing the size of each field and describing what each does.

[5]

- e) Given a **3 Mbps** satellite link connecting two ground stations, find the bit length of the link. The bit length is defined as a frame whose size is such that when the first bit of the frame reaches the receiver, the last bit of the frame is leaving the sender. The satellite is located **36,000 km** above the earth's surface, and electromagnetic waves travel at **300,000 km/s** in air and vacuum.

[4]