

UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

SUPPLEMENTARY EXAMINATION 2006

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.

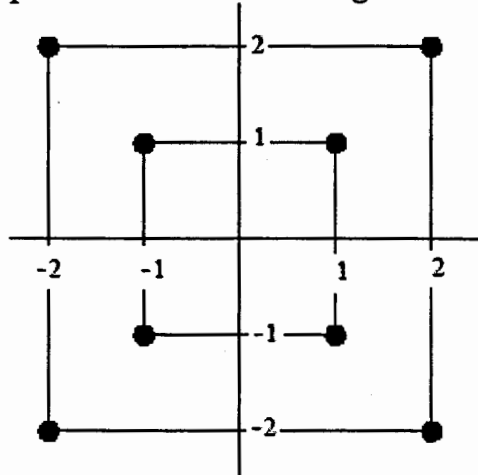
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QUESTION 1

- 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 [6]
(ii) Phase shift modulation. [6]
- d) Using phase shift modulation, show how **3 bits** per baud can be transmitted. [4]
- e) What is the difference between bit rate and baud rate? [2]

QUESTION 2

- a) What is the OSI Model? Describe the function of each layer of the OSI Model. [10]
- b) Given the constellation diagram below, how many different amplitudes and phase shifts does the diagram have?



- c) How many bits are transmitted per baud? [4]
- d) In pulse code modulation, what is the sampling rate, and why this rate? [3]
- e) With the assistance of an example, describe how character stuffing works. [5]
- [3]

QUESTION 3

- a) 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]
- b) 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) A digital signal has a bit interval of 10 micro seconds. What is the bit rate? [3]
- c) What is Hamming Distance? Find the Hamming Distance for the codewords **10010101, 00000000, 10111001, 10000001**. [3]
- d) Determine the transmitted codeword for the message word given by the polynomial $x^7 + x^4 + x^3 + x$, using the generator polynomial $x^3 + 1$. [4]
- e) Show the encoded signal if the bit stream 1100111010010110 is encoded using
(i) Differential Manchester encoding
(ii) MLT-3 encoding. [6]

QUESTION 4

- a) Describe the format of an **IEEE 802.3** frame, and indicate how it differs from an **Ethernet II** frame. [5]
- b) Describe the operation of the CSMA/CD medium access control (MAC) protocol. [5]
- c) Find the Hamming Code for the bit string **10100**. Odd parity is used for the check bits. [3]
- d) 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. [3]
- e) Assume a dog has been trained to carry a box of five, 700MB data CDs. The dog can travel at 20 Km/hr. For what range of distances does the dog have a higher data rate than a 2048 Kbps data line? [5]
- f) Explain the terms circuit switching and packet switching. [4]

QUESTION 5

a) Explain in detail the operation of an Ethernet bridge when used to connect two Ethernet LAN segment. Your description should include reasons why a bridge is introduced in a LAN.

[5]

b) Describe simplex stop-and-wait flow control protocol and sliding window flow control.

[7]

c) What is the advantage of sliding-window flow control compared to stop-and-wait flow control?

[3]

d) Consider the use of 1000-bit frames on a 1-Mbps satellite channel with a 270ms delay. What is the maximum link utilization for stop-and-wait flow control?

[5]

e) Wireless LANs operate at frequencies between 902MHz and 928MHz and 2.4 GHz and 2.4835GHz. yet the data speeds supported by wireless are less than those supported by category 5 UTP which operates at frequencies from 0 to 100 MHz. Explain why this is the case.

[3]

f) What are the reasons for breaking a long data transmission up into a number of frames?

[2]