UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

MAIN EXAMINATION 2006

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

COURSE NUMBER: CS440 (I)

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER QUESTION **1** AND **ANY THREE** OF THE OTHER FOUR QUESTIONS.

EACH QUESTION CARRIES **25 MARKS.**

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

QUESTION 1 (Compulsory)

a) Identify the layers of the OSI Reference Model where the following would be used:

- Frame sequence number
- MLT-3 encoding
- IP protocol version number
- TCP header length
- Encryption
- Destination port
- Email address

[7]

b) What bandwidth is required to put a T1 signal (1.544Mbps) on a 30dB transmission medium?

[5]

c) Describe three different types of data network topologies, using diagrams to illustrate each type.

[6]

d) What differentiates LANs, MANs and WANs?

[4]

e) When would it be appropriate to use fibre optic cable instead of copper cables in data networks?

[3]

QUESTION 2

a) Given the binary information **0101100100100 1**, show how it can be transmitted over an analogue transmission medium using

(i) Amplitude shift keying
(ii) Quadrature phase shift keying

[8]

b) Describe Pulse Code Modulation and explain why it is used in Public Switched Telephone Networks.

[7]

c) A certain transmission channel allows for frequencies between 902 MHz and 928 MHz and has a signal to noise ratio of 24dB. What is the channel's capacity?

[5]

d) 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.

[5]

QUESTION 3

a) How long does it take to transmit x KB over a y-Mbps link? Give your answer as a ratio of x and y

[3]

b) A **2400 baud** modem uses the constellation diagram show in figure 1. What is the data rate of the modem? What modulation scheme is the modem using?

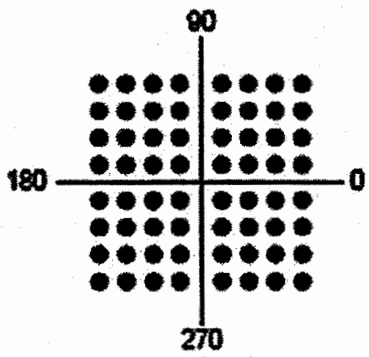

Figure 1: Constellation diagram

[4]

c) Show the encoded signal if the bit stream **110000101011** is encoded using

(i) Differential Manchester encoding
(ii) bipolar-AMI
(ii) MLT-3 encoding

[8]

d) A message of **15000 bytes** is being sent using message and packet switching, with packets being **5000 bytes**, from node A to node C, via node B, as shown by the diagram in figure 2. Determine the time between the first bit leaving node A and the last bit reaching node C for each of **message** and **packet** switching. Ignore the processing delay at each node. The propagation speed for the links connecting any two nodes is 2.5×10^8 m/s.

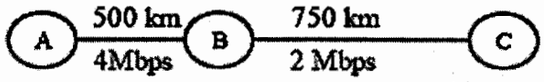

Figure 2

[8]

e) Why must satellite have distinct uplink and downlink frequencies?

[2]

QUESTION 4

a) Using the generator polynomial $G(x) = x^3 + x + 1$, find the transmitted codeword T(x), if the data bit string is **11001011100**. If bit 8 of the code word incurs an error, show how the error is detected.

[7]

b) Is the following ISBN **0-7679-3086-2** valid? Find the last digit for the ISBN **0-7679-0382**.

[6]

c) Draw a diagram for the **IEEE 802.3** frame and the **Ethernet II** frame. If the total length of the IEEE 802.3 frame is 1000 bytes, show the actual values of the fields that can be deduced from this information. Explain your answer.

[7]

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

[5]

QUESTION 5

a) Provide a description of the key differences between a hub, a switch, a bridge and an IP router.

[4]

b) Sixteen stations are contending for the use of a shared channel using the adaptive tree walk protocol. If all the stations whose addresses are prime numbers suddenly become ready at once, how many bit slots are required to resolve the contention?

[5]

c) A Go back n protocol uses 5 bit frame sequence numbers. What is the window size at the sender? What is the window size at the receiver? If the sender sends the maximum number of frames possible, starting with frame 0, and frame 8's timer goes off, which frames need to be retransmitted?

[7]

d) Suppose nodes A and B are on the same 10 Mbps Ethernet segment and the propagation delay between the two nodes is 290 bit times. Suppose node A transmits a 72 byte frame and before it finishes, node B begins transmitting a frame. Show that A will transmit the entire frame before it detects a collision and discuss the consequences.

[5]

e) Explain the terms circuit switching and packet switching.

[4]