

UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

SUPPLEMENTARY EXAMINATION 2007

TITLE OF PAPER: DATA NETWORK AND CODING THEORY I

COURSE NUMBER: CS437

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER ANY FOUR.

EACH QUESTION CARRIES 25 MARKS.

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

QUESTION 1

- a) What differentiates LANs, MANs and WANs? [4]
- b) Describe how fibre optic is used to transmit data and state where it would be appropriate to use. [5]
- c) A **9600 baud** modem uses a constellation diagram with data points at the following coordinates: (1,0), (3,0), (1,1), (2,2), (3,3), (-1,0), (-3,0), (-1,1), (-2,2), (-3,3), (-1,-1), (-2,-2), (-3,-3), (1,-1), (2,-2), (3,-3). How many amplitude levels and phase levels are employed? What is the data rate in Kbps of the modem? [6]
- d) 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]
- e) Describe Frequency Division Multiplexing and Time Division Multiplexing, indicating what type of signal use each type of multiplexing. [5]

QUESTION 2

- a) Given the binary string **010110010**, show how it can be transmitted over an analogue transmission medium using
(i) Frequency modulation
(ii) Phase shift modulation. [5]
- b) Describe the structure of the public switched telephone network; indicate in your description the different types of media that can be used in the local loop. [5]
- c) A certain transmission channel allows for frequencies between 125 KHz and 195 KHz and has a signal to noise ratio of 24dB. What is the channel's capacity? [4]
- d) Determine the transmitted codeword for the message word given by the polynomial $x^7 + x^3 + x$, using the generator polynomial $x^3 + x$. [3]
- e) Show the encoded signal if the bit stream 11001110 is encoded using
(i) Manchester encoding
(ii) MLT-3 encoding. [4]

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

- Frame sequence number
- MLT-3 encoding
- MAC destination address
- Hubs

[4]

QUESTION 3

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

[4]

b) If the bit string 011110111110111110 is subjected to bit-stuffing, what is the output string?

[3]

c) What bandwidth is required to put an E1 signal (2048 Kbps) on a 34dB transmission medium?

[4]

d) A channel has a data rate of 256 Kbps and a propagation delay of 15 ms. For what range of frame sizes does stop-and-wait give an efficiency of at least 75%?

[4]

e) Consider the use of 1500 bit frames on a 2 Mbps satellite link with a 270 ms delay. What window size will give an efficiency of at least 85%?

[4]

f) Frames are generated at node A and sent to node C through node B as shown by the diagram below. The data rate between A and B is 100 Kbps, and the propagation delay is $5 \mu\text{s}/\text{km}$ for both lines. All data frames are 1000 bits long and ACK frames are of negligible size. Between A and B a sliding window protocol with a window size of 3 is used. Between B and C stop-and-wait is used. The transmission medium is assumed to be error free.

Determine the minimum data rate required between nodes B and C so that the buffers of node B are not flooded.

Hint: In order not to flood buffers of B, the average number of frames entering and leaving B must be the same over a long interval.



[6]

QUESTION 4

- a) Draw a diagram for the **IEEE 802.3** frame and the **Ethernet II** frame. What are the minimum and maximum frame sizes of the two frame types? [7]
- 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) Define channel bandwidth and channel capacity. [4]
- d) Why must satellite have distinct uplink and downlink frequencies? [2]
- e) Describe **Go back N** and **Selective Repeat** error control making sure to highlight the differences between them [6]

QUESTION 5

- a) What is the Medium Access Control (MAC) protocol? Describe the operation of the CSMA/CD medium access (MAC) protocol. [5]
- b) Describe how stations implementing the IEEE 802.3 specification implement the medium access control protocol. [4]
- c) 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]
- d) Describe Pulse Code Modulation and explain why it is used in Public Switched Telephone Networks. [5]
- e) What is the advantage of sliding-window flow control compared to stop-and-wait flow control? [2]
- f) Is the following ISBN **1-56952-322-7** valid? Find the last digit for the ISBN **0-13-162959**. [4]