UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

SUPPLEMENTARY EXAMINATION 2014

TITLE OF PAPER: NETWORKS AND CODING THEORY I

COURSE NUMBER: CS437

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER **ANY FOUR** QUESTIONS.

EACH QUESTION CARRIES **25 MARKS**.

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BY THE INVIGILATOR.

QUESTION 1

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

[6]

b) Use clear diagrams to show the encoded signal if the bit string **1100100110110010** is encoded using:
   i) Non-return to Zero
   ii) Differential Manchester encoding
Assume that the signal has a negative voltage before the first bit is transmitted

[6]

c) Show the encoded analogue signal if the bit string in **b)** is encoded using:
   i) Frequency Shift Keying
   ii) Quadrature Phase Shift Keying

[6]

d) What differentiates LANs from WANs?

[4]

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

[3]

QUESTION 2

a) An image is 1024 x 768 pixels with 3 bytes per pixel. Assume the image is uncompressed. How long does it take to transmit over a 128 Kbps channel?

[3]

b) A message of **7500 bytes** is being sent using packet switching from node A to node C, via node B, as shown by the diagram below. The link between nodes A and B is a 1000 Km fibre optic link, while the nodes B and C are connected by a satellite link, where the satellite is located 35, 500 km above the earth's surface. The propagation speed for fibre optic is 200, 000 Km/s, while the propagation speed over air or vacuum is 300, 000 Km/s. Given that the maximum packet size is **2500 bytes**, find the time it takes for the message to be sent from A to B.

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   ( A )------( B )-----------( C )
      5 Mbps      20 Mbps
```

[7]
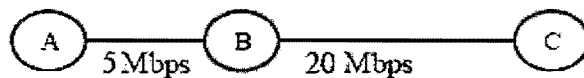
c) Wireless local area networks operate at frequencies between 902MHz and 928MHz and 2.4 GHz and 2.4835GHz. yet the data speeds supported by wireless are less than those supported by category 5 UTP which operates at frequencies from 0 to 100 MHz. Explain why this is the case.

[3]

d) What is the function of the twists in twisted pair wire?

[3]

e) Draw a diagram for the **IEEE 802.3** frame. If the total length of the frame is 1000 bytes, show the actual values of the fields that can be deduced from this information.

[6]

f) How is it possible for voice and data transmission to be done simultaneously on ADSL lines? Why are the lines called **Asymmetric** Digital Subscriber Lines?

[3]

QUESTION 3

a) What is Pulse Code Modulation?

[3]

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

[4]

c) For sliding window protocols, what is:
        Sender Window
        Sender Window size
        Receiver Window

[4]

d) 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.

[2]

e) Find the Hamming Code for the bit string **10100111**. Odd parity is used for the check bits.

[4]

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

[4]

g) 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]

QUESTION 4

a) If the characters **A B C DLE STX DLE DLE EXT Z R DLE E DLE are** subjected to character stuffing, what is the output after stuffing?

[5]

b) Describe the following ARQ protocols making sure to highlight the differences between them
        (i)   Go back N ARQ
        (ii)   Selective repeat

[6]

c) Consider the use of 512 bytes frames on a 1 Mbps satellite channel with a 270ms delay. What is the maximum link utilization for stop-and-wait flow control? Acknowledgement frames are 40 bytes.

[4]

d) Describe the MAC protocol of IEEE 802.3.

[5]

e) 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) Describe Frequency Division Multiplexing and Time Division Multiplexing, indicating what type of signals use each type of multiplexing.

[6]

b) Explain the terms circuit switching and packet switching.

[4]

c) Bits are transmitted from Cairo to Mbabane over an optic fibre link at 2 Mbps (1 Mbps = 10^6 bps). The propagation speed is 2×10^5 km/s, and the total length of the fibre is 5150 km. Find how many bits have been transmitted and are propagating over the fibre when the first bit reaches Mbabane.

[5]

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.

[4]

e) Determine the transmitted codeword for the message word given by the polynomial $x^5 + x^4 + x^2 + x$, using the generator polynomial $x^3 + 1$.

[4]

f) 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 64000 bps. What is the duration of each bit?

[2]

End of Question Paper