UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

SUPPLEMENTARY EXAMINATION 2015

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) Use clear diagrams to show the encoded signal if the bit string **C9B2** is encoded using:

      i) Non-return to Zero Inverted

      ii) Manchester encoding

Assume that the signal has a negative voltage before the first bit is transmitted

[6]

b) Show the encoded analogue signal if the bit string in **a)** is encoded using:

      i) Frequency Shift Keying

      ii) Amplitude Shift Keying

[6]

c) Find the Hamming Code for the bit string **11110010**. Even parity is used for the check bits.

[4]

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

[5]

e) 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.

[4]

QUESTION 2

a) What bandwidth is required to put a T1 signal (1.544 Mbps) on a 35dB transmission line?

[4]

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

[6]

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

[6]

d) 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]

e) For sliding window protocols, what is?

      Sender Window

      Sender Window size

      Receiver Window

[4]

f) Why is slotted Aloha more efficient than pure Aloha?

[2]

QUESTION 3

a) A channel has a data rate of 512 Kbps and a propagation delay of 10 ms. For what range of frame sizes does stop-and-wait give an efficiency of at least 90%?

[4]

b) 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]

c) Define channel bandwidth and channel capacity.

[4]

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

[5]

e) Using phase shift modulation, show how **4 bits** per baud can be transmitted.

[3]

f) A person on a bicycle travelling at 50 Km/hr can carry 5 DVDs, each DVD containing **4.7 GB** of data. For what range of distances would it be faster to use the person on the bicycle to transfer the information on 5 DVDs, than to use a **20 Mbps** data line to transfer the data?

[5]

QUESTION 4

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

[4]

b) Draw a diagram for the **IEEE 802.3** frame. If the total length of the frame is 1500 bytes, show the actual values of the fields that can be deduced from this information.

[6]

c) Describe the Selective repeat ARQ protocol.

[4]

d) Consider the use of 2048 bytes frames on a 1 Mbps satellite channel with a 240ms delay. What is the maximum link utilization for stop-and-wait flow control? Acknowledgement frames are 40 bytes.

[4]

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

[4]

f) Define the Hamming distance for a group of codewords.

[3]

QUESTION 5

a) Differentiate between guided media and unguided media.

[3]

b) Describe how data is transmitted using fibre optic cable.

[3]

c) Describe the medium access control protocol of IEEE 802.3.

[5]

d) Ethernet supports broadcast, unicast and multicast transmission modes. Explain what is meant by each term.

[4]

e) For the diagram given, calculate the time it takes to transmit 60 KB of data using message switching and packet switching with a maximum packet size of 1500 bytes from Host A to Host B.

| Host A | Router 1 | Router 2 | Router 3 | Host B |
| 256 Kbps | 1024 Kbps | 2048 Kbps | 256 Kbps | |
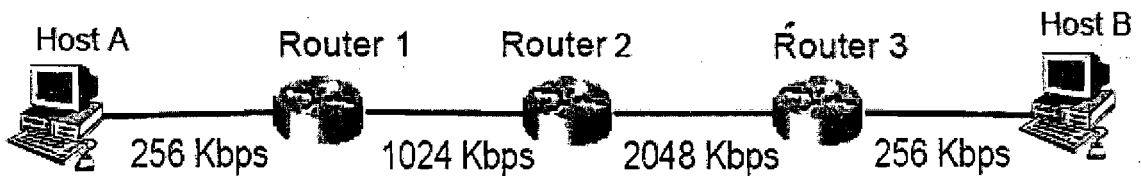
Link between Host A and Router 1 is a 10 Km coaxial cable
Link between Router 1 and Router 2 is a 2500 km fibre optic link
Link between Router 2 and Router 3 is a satellite link, with the satellite relay station is located 35, 650 km above the earth's surface.
Links between Router 3 and Host B is a 10 Km coaxial cable. The propagation speed in copper and glass is 200, 000 km/s, while on air or vacuum, the propagation speed is 300, 000 Km/s.

[10]

End of Question Paper