

**UNIVERSITY OF SWAZILAND**

**Faculty of Science**

**Department of Computer Science**

**MAIN EXAMINATION - DECEMBER 2018**

**Title of Paper: NETWORKS AND CODING THEORY I**

**Course Number: CS437/CSC431**

**Time Allowed: 3 hours**

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**Instructions to candidates:**

*This question paper consists of FIVE (5) questions. Answer any FOUR (4) questions*

*Marks are indicated in square brackets.*

*All questions carry equal marks (25 Marks Each).*

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THE INVIGILATOR.**

## QUESTION 1

- a) i) What is the open systems concept as applied to network models? [2]
- ii) State any 3 reasons why we use the layered structure for computer networks? [3]
- iii) What is the difference between a protocol and an interface? [2]
- b) The Physical layer, Data Link layer and Network layer are layers in the OSI reference model. Describe the key functions of these three (3) layers. [9]
- c) Operations of similar functionality can be performed at different layers of a protocol stack. With reference to the OSI reference model which layer, layers, or sub layer is associated with each of the following terms, functions,
- i) Routing
  - ii) Encryption
  - iii) Error detection and correction
  - iv) Flow control and framing
  - v) Signaling/ Data Encoding [5]
- d) Describe the fundamental difference between cross over and straight through twisted pair cables? [4]

## QUESTION 2

- a) Use clear diagrams to show the encoded signal if the bit string **001110011011** is encoded using:
- i) MLT-3
  - ii) Differential Manchester encoding (Assume that the signal has a negative voltage before the first bit is transmitted). [6]

b) If the bit stream in (a) is first encoded using 4B/5B and then encoded using Non-return to zero inverted, show the transmitted signal. The 4B/5B table is given below:

4-Bit Data Symbol	5-Bit Code
0000	11110
0001	01001
0010	10100
0011	10101
0100	01010
0101	01011
0110	01110
0111	01111
1000	10010
1001	10011
1010	10110
1011	10111
1100	11010
1101	11011
1110	11100
1111	11101

c) Bits are transmitted from Cairo to Mbabane over an optic fibre link at 5 Mbps. The propagation speed is 200,000 km/s, and the total length of the fibre is 6000 km. Find how many bits have been transmitted and are propagating over the fibre when the first bit reaches Mbabane. [4]

d) What signal-to-noise ratio (in dB) is needed to put a T1 carrier on a line with a 100 kHz bandwidth? [4]

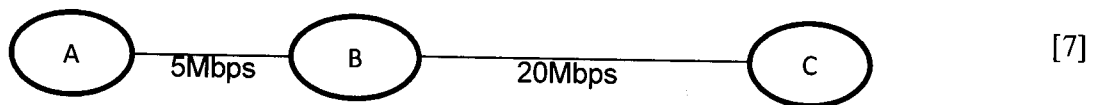
e) A digital signal has a bit interval of 10 microseconds. What is the bit rate? [3]

f) An analogue signal carries four bits in each signal element. If 2500 signal elements are sent per second, what is the baud rate and the bit rate? [4]

### QUESTION 3

- a) State two (2) functions of the data link layer? [2]
- b) 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]

c) 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 3S, 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.



- d) 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]
- e) What is the function of the twists in twisted pair wire? [3]
- f) State the Shannon's major result formula for Maximum Data Rate of a Channel and calculate the capacity of a noisy channel whose bandwidth is 1 MHz and signal-to-noise ratio 40 dB. [4]
- g) 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 4

- a) Explain the difference between error correction and error detection. Which approach requires more information? [5]
- b) A person on a bicycle travelling at 50 km/hr can carry 5 DVDs, each DVD containing **4.7 GB** (1 GB =  $2^{30}$  bytes) 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 **25 Mbps** (1 Mbps =  $10^6$  bps) data line to transfer the data? [5]
- c) Distinguish between unicast, broadcast, and multicast. [3]
- e) In the standard Ethernet with the transmission rate of 10 Mbps, we assume that the length of the medium is 2500 m and the size of the frame is 512 bits. The propagation speed of a signal in a cable is normally  $2 \times 10^8$  m/s. Calculate the efficiency? [2]
- e) The encoder has this codeword **1010001101** to be transmitted. Using the generator (divisor)  $x^5 + x^4 + x^2 + 1$  calculate the CRC and show the message to be transmitted. [5]
- The decoder will receive the transmitted message and check for errors. Compute the remainder from the received message and state what will happen thereafter. [5]

#### QUESTION 5

- a) Briefly describe the following techniques:
- i) Phase Shift Keying (PSK) [3]
  - ii) Pulse code modulation (PCM) [3]
- b) Consider host IP 172.16.0.0/16 to design a network in a new office building where number of Computers (host) 100 and Six departments (Networks). Calculate the following terms: [7]
- i. Number of Sub-Net Bits
  - ii. Number of Host Bits

- iii. Total Network Bits
- iv. Maximum possible Network
- v. Maximum Valid Host/Network
- vi. Default Get way

Also write the Network address, Host IP address range and Broadcast address for every department.

d) Explain leaky bucket algorithm and compare it with token bucket algorithm. [6]

e) What is IP addressing? How it is classified? Briefly explain how subnet addressing is performed. [6]

**!!!End of Question Paper!!!**