UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

MAIN EXAMINATION DECEMBER 2010

Title of paper: **NETWORKS AND CODING THEORY – I**

Course number: **CS437**

Time allowed: **3 hours**   Total Marks: **100**

Instructions to candidates:
This question paper consists of **SIX (6)** Questions. Answer any **FOUR (4)** questions.
Marks are indicated in the square brackets.
All questions carry equal marks.

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QUESTION 1

a) Explain the Open Systems concept in relation to networks. By means of a protocol layer diagram based on the ISO seven layer reference model, show how data is transmitted from one computer to another over a network and clearly indicate on the diagram what is meant by a 'peer to peer' protocol and an interface.   [8]

b) i) List 2 International Standard Bodies whose work has got something to do with networking. Briefly explain 2 advantages of having International Standard bodies. [4]

   ii) With reference to the OSI reference model which layer, layers, or sublayer is associated with each of the following terms, functions,   [7]
   - Bit stuffing
   - CRC
   - Routing
   - Flow control
   - Encryption
   - Channel access
   - IP addressing

c) In a layered network architecture what is meant by the term *data encapsulation*? [2]

d) List 4 of the parameters of interest for comparing the different types of transmission media?   [4]

QUESTION 2

a) i) An 8-bit word **10011001** is to be encoded using an even-parity Hamming code. How many check bits are needed to ensure that the receiver can detect and correct single bit errors? (You are not required to compute the codeword)   [3]

   ii) In a data communication network, a sender encodes all 7-bit ASCII characters using Hamming code before transmission to a receiver. Assuming that a receiver in the network receives the bit pattern **10111001001**, Use the Hamming code scheme to check the bit pattern, indicate any error and show how the error can be corrected. Indicate the ASCII character that has been transmitted.   [10]

b) If a physical network is based on i) optical fibre, ii) shielded copper wire or ii) uses wireless transmission, explain which is the least likely to produce errors and which is most likely to produce errors and why?   [6]

c) Explain the difference between error detection and error correction. Which approach requires more information to be sent, in addition to the original data?   [4]

d) i) Ethernet LAN uses Manchester encoding. State one advantage of Manchester coding over NRZ coding and one disadvantage (of Manchester over NRZ).   [2]

QUESTION 3

a) With the aid of clear diagrams show the encoding for the bit stream: **01001101001** using
   i) NRZ-I encoding,
   ii) Manchester encoding and
   iii) Differential Manchester encoding.   [3 marks each]

b) i) State 4 causes or components of delay in a packet switched network?   [4]

   ii) State one significant advantage of Datagram packet switching compared to Virtual Circuit packet switching. State one significant advantage of Virtual Circuit compared to Datagram packet switching.   [2]

c) Given a channel with an intended capacity of 20Mbps. The bandwidth of the channel is 3MHz. What is the Signal-to-Noise ratio required in order to achieve this capacity? [4]

d) Briefly describe the operation of the following medium access protocols:
   i)   1-persistent CSMA
   ii)   Slotted ALOHA   [3 marks each]

QUESTION 4

a) Consider using a 4 kHz channel and 16 discrete levels to send data. What is the maximum possible transmission rate if the channel is noiseless? What if the signal to noise ratio is 30dB?   [6]

b) Compare parity check with CRC in terms of computation complexity and error detection rate.   [5]

c) Two antennas at a height 150m are supposed to communicate. Assuming that there are no intervening obstacles, what is the maximum distance that can be between the 2 antennas?   [4]

d) Draw example timing diagrams to show how a **Stop-and-wait ARQ** scheme copes with: [6]
        i)   A damaged data frame;
        ii) A lost data frame;
        iii) A lost ACK.

e) Is voice transmission best suited to connection oriented or connectionless service? [4]
   Explain your answer.

QUESTION 5

a) Suppose a computer is moved from the Computer Science Department at Kwaluseni campus to another department at Luyengo campus. Does its MAC address need to be changed? Does the IP address need to be changed? Give reasons for your answer. [4]

b) Briefly explain what happens in CSMA/CD when a node detects that its data has suffered a collision? [3]

c) A commonly used network access technology for providing Internet access to a home is Asymmetric Digital Subscriber Line (ADSL). Explain what is meant by the term 'asymmetric' and why it is particularly suited to accessing the world wide web? [4]

d) State any 4 parameters of interest for comparing different types of transmission media? What is the main difference between CAT 3 and CAT 5 UTP cables? Describe the fundamental difference between cross over and straight through twisted pair cables? [8]

e) Distinguish between Frequency division and Time division multiplexing. [6]

QUESTION 6

a) The serial ports on two computers which use binary signaling are connected by a twisted pair cable. The cable has a flat frequency response up to 12 kHz, with negligible group delay distortion. [10]

      i. What is the maximum information transfer rate that can be accommodated by the cable, assuming a noise-free environment?

      ii. If the noise introduced by the cable is -40 dB with respect to the signal power, what is the resulting maximum information transfer rate?

b) Given the data, $M(x) = 01011100$, assuming CRC is used with a generator function $G(x) = 11001$. Find the bit string $T(x)$ to be transmitted [5]

c) Give three (3) characteristics that differentiate between LANs and WANs. [3]

d) Compare **Go-back-to-N ARQ** and **Selective Repeat ARQ** when the second frame is lost during the transmission from Sender to Receiver with a sliding window of size 8. What happens if the ACK that confirms the correct arrival of frames 0, 1 and 2 is lost on its way from the Receiver to the Sender in the two cases? [7]

<<End of Question Paper >>