UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

MAIN EXAMINATION 2008/9

Title of Paper: NETWORKS AND CODING THEORY – I

Course Number: CS437

Time Allowed: 3 hours

Instructions to candidates:

This question paper consists of SIX (6) questions. Answer any FOUR (4) questions.
Marks are indicated in square brackets.
All questions carry equal marks.

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GRANTED BY THE INVIGILATOR

QUESTION 1

a) What is the open systems concept (in the context of the OSI model)? What are the two key differences between a protocol and an interface? What are the names and functions of the three lowest layers in the OSI model? State any three reasons for the layering?
[10]

b) Services and protocols conforming to OSI standards have only a tiny share of the world's data communication market. Discuss some reasons why this situation has arisen despite the considerable international effort expended in defining and promoting OSI standards.
[6]

c) What are the differences between frequency division multiplexing and time division multiplexing? Provide a diagram for each in your answer.
[4]

d) What was the original goal (or motivation) for ISDN? Briefly describe ISDN.
[5]

QUESTION 2

a) An 8-bit byte with binary value **10101111** 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? What is the binary value, **codeword**, after encoding?
[6]

b) If a binary signal is sent over a 3 kHz channel whose signal-to-noise ratio is 20dB, what is the maximum achievable data rate?
[5]

c) Compare parity check with CRC in terms of computation complexity and error detection rate.
[6]

d) Using the CRC method, what frame, $T(x)$, will be transmitted for the data message $M(x) = $ **11000111110101110** and the generator polynomial $G(x) = x^5 + x^2 + 1$? Why is modulo-2 arithmetic used in calculating CRC's?
[8]

QUESTION 3

a) Describe the differences between DSL and Cable Modem in terms of speed, shared or not shared media? Is the download speed bigger or upload speed bigger? Why? [6]

b) What are the factors that affect the choice of a LAN topology? [4]

c) Explain the operation of the following LAN topologies:

      i. Bus/Tree topology
      ii. Star wired ring topology [8]

d) With the aid of clear diagrams show the encoding for the bit stream:
M = **01101100101** using NRZ-I encoding, Manchester encoding and Differential Manchester encoding. Assume the first bit starts at a high voltage level. [7]

QUESTION 4

a) Explain how a simple ALOHA system works and explain what improvement is brought about by the Slotted ALOHA system. [6]

b) Two Ethernets can be interconnected using a bridge, which forwards packets between the networks at the OSI Data link layer. Describe the operation of an Ethernet bridge. Describe the bridging table and forwarding/learning algorithm. Give the three names used for a bridge. [8]

c) Explain the operation of the Carrier-Sense Multiple Access with Collision Detection (CSMA-CD) channel allocation algorithm and discuss how its performance compares with that of pure CSMA strategies. [6]

d) Briefly describe the following techniques:
      i. Phase Shift Keying (PSK)
      ii. Pulse code modulation (PCM) [5]

QUESTION 5

a) "Packet switching provides more efficient communication of data between computers than is possible with circuit switching". Briefly contrast the end-to-end characteristics of a packet –switching network compared with those of a circuit switched network. What are the fundamental differences between the two approaches of packet switching? [8]

b) i) What is the main difference in terms of application between cross-over and straight through twisted cables? [2]

ii) List any two data communication standard bodies and state their role. [4]

c) Automatic Repeat Request (ARQ) protocols aim to provide reliable, sequenced, flow controlled frame delivery.
   i. How does frame loss occur in a network? [2]
   ii. Give brief descriptions of how the Go-Back-N and Selective Repeat protocols work. [4]

d) Assume the message to be sent is the word "LAN" and the ASCII coding scheme is used. Complete the table below to show the byte representation for each character as well as the Longitudinal Redundancy Check (LRC)/ (BCC) for the frame. Consider even parity. *Show all your working* [5]

Character	Byte (8 bit representation)	Parity bit (Even parity)
L		
A		
N		
LRC (BCC)		

QUESTION 6

a) What MAC protocol does Ethernet use? Describe the operation of the CSMA/CA algorithm. What are the basic differences between Ethernet switch and hub? [10]

b) Demonstrate your knowledge of the following types of Access Network. You should discuss any special challenges posed by each transmission medium, describe the current technology, and comment on any commercial factors pertinent to its deployment.

      i. Optical fibre to the home.
      ii. Satellite. [3 each]

c) Explain why digital rather than analogue transmission is favored in modern communication systems. [3]

d) Explain the term Bandwidth as applies to communication channels and how it limits the baud rate. [3]

e) Describe the operation of credit based flow control. [3]

<<End of Question Paper>>