

UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Electronic Engineering

MAIN EXAMINATION 2009

**Title of Paper: COMPUTER NETWORKS & OPEN SYSTEMS
INTERCONNECTIONS**

Course Number: ECO 520

Time Allowed: 3 hours

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.

**THIS EXAMINATION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN
GRANTED BY THE INVIGILATOR**

QUESTION 1

- a) i) What are the names and functions of the three lowest layers in the OSI model?
State any three reasons for the layering? [8]
- ii) Services and protocols conforming to OSI standards have only a tiny share of the world's data communication market. Discuss the reasons why this situation has arisen despite the considerable international effort expended in defining and promoting OSI standards. [5]
- b) Suppose you have a channel from 10 000Hz to 22 000 Hz, with an SNR of 18dB. Assuming that you can achieve about 1/3 of the Shannon limit,
i) What is the data rate of your channel and
ii) How many signal elements/levels should you use? [5]
- c) Why is routing necessary in networks? What are the major properties of routing algorithms? [4]
- d) On an ISDN connection, what device separates the voice signal from the data signals at the customer premises? [3]

QUESTION 2

- a) What is different about the method used to boost a digital signal's strength, compared with the method of boosting an analog signal's strength? [3]
- b) i) Define the Hamming Distance between two codewords. [2]
- ii) One way of detecting errors is to transmit data as a block of n rows of k bits per row and adding parity bits to each row and each column. Will this scheme detect all single errors? Double errors? Triple errors? [3]

iii) 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)		

iv) 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? [5]

- 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? [3]

QUESTION 3

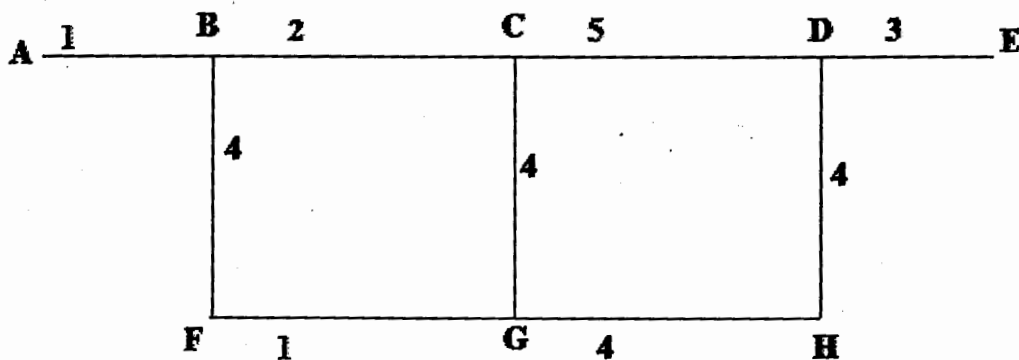
- a) With the aid of clear diagrams show the encoding for the bit stream: **01001101001** using NRZ-I encoding, Manchester encoding and Differential Manchester encoding. Assume the first bit starts at a high voltage level. [9]
- b) Why is packet switching more efficient than circuit switching? [6]
- c) What happens in CSMA/CD when a node detects that its data has suffered a collision? [4]
- d) Compute the CRC for a given message (M) and a generator polynomial (G). Data ($M(x)$) = **101001101**, $G(x)$ = **100111**. Find $R(x)$ and hence find the transmitted message, $T(x)$. Why is **Modulo 2** arithmetic used in calculating CRCs? [6]

QUESTION 4

- a) Two Ethernets can be interconnected using a bridge, a hub or a switch which forwards packets between the networks at the OSI Data link layer. Describe the operations of a hub and a switch. [6]
- b) Distinguish between TCP and UDP, explaining the kinds of applications to which each is suited. [10]
- c) Give a detailed account of the following congestion control techniques for virtual circuit and datagram networks:
- i) Choke packets
 - ii) Jitter control
 - iii) Load shedding [3 marks each]

QUESTION 5

- a) Automatic Repeat Request (ARQ) protocols aim to provide reliable, sequenced, flow controlled frame delivery. Give brief descriptions of how the Go-Back-N and Selective Repeat protocols work. [6]
- b) What are the two key components of an IP address? List and describe the main address classes initially used on the Internet. [7]
- c) The IPv4 address space is considered to be too small to accommodate future Internet growth. Explain some of the reasons for this. [4]
- d) Use Dijkstra's algorithm to find the shortest path from node A to all of the other nodes in the undirected graph below. Show each step of the algorithm (i.e., show the order in which edges are selected). Give the final path costs. Link costs are as shown on the figure below. Use a separate sheet of paper to show your work and your solution. [8]



<< END OF QUESTION PAPER >>