

UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC

ENGINEERING

MAIN EXAMINATION 2012

TITLE OF PAPER: COMPUTER NETWORKS

COURSE NUMBER: EE572

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER ANY FOUR QUESTIONS.

EACH QUESTION CARRIES **25 MARKS**.

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BY THE INVIGILATOR.

QUESTION 1

- a) Describe the functions of each layer of the OSI Reference Model. [10]
- b) What differentiates LANs, MANs and WANs? [5]
- c) Describe the binary back-off algorithm used by Ethernet. [5]
- d) Explain the two main functions that are performed by a router. [3]
- e) Define the Hamming Distance for a group of the codewords. [2]

QUESTION 2

- a) What is the function of the twists in twisted pair wire? [2]
- b) Show the encoded signal if the bit stream **0011010100** is encoded using
(i) NZR-I
(ii) MLT-3
Assume the signal has a negative voltage prior to the transmission of the first bit. [5]
- c) The bit string **1111000111111111010111100** needs to be transmitted at the data link layer. What is the string transmitted after bit stuffing? [3]
- d) Show the transmitted bit string if the message **1001001110** is to be transmitted with CRC being used for error detection, and the generator polynomial used being $x^4 + x^3 + 1$. [5]
- e) The bandwidth-delay product of a link is defined as the maximum number of bits that can be in the link, and in other words it means when the first bit transmitted reaches the Receiver at the other end of the link, the last bit is leaving the Sender. Calculate the bandwidth-delay product for a **1 Mbps** satellite link, given that the satellite is located **36, 000 km** above the earth's surface and the propagation speed for electromagnetic signals in air and vacuum is **300, 000 km/s**. [5]
- f) Given the binary information **110010100101**, show the analogue signal form if it is transmitted over an analogue transmission medium using
(i) Frequency modulation
(ii) Quadrature Phase shift modulation [5]

QUESTION 3

- a) A channel has a propagation delay of 65 ms and a bit rate of 128 Kbps. For what range of frame size does stop-and-wait give an efficiency of at least 65%? [4]
- b) Describe Go-back-n flow control and explain how it differs from Selective Repeat flow control. [4]
- c) A transmission channel supports signals with frequencies between 5000 Hz and 85000 Hz, and has a signal to noise ratio of 20 dB. What is the maximum data rate of the channel? [3]
- d) Discuss the following CSMA protocols [3]
- (i) 1-persistent CSMA
 - (ii) non-persistent CSMA/CD
- e) Draw the diagram of an HDLC frame and describe the function of each field. [6]
- f) What are the 3 frames supported by HDLC and what is their function? [5]
- [3]

QUESTION 4

- a) If a 4000 byte IP datagram needs to traverse a link that has a maximum transfer unit of 850 bytes, describe what will happen to the datagram at the router that is connected to the link if fragmentation is allowed on the datagram. [5]
- b) How is the IPv4 header checksum calculated? [2]
- c) Given the IP network 196.100.2.0, how many subnets would result if the maximum number of hosts per subnet is 14? What is the subnet mask? [5]
- d) Given the IP address 172.16.10.82/26, calculate the broadcast address and the minimum ip address of the network. [4]

e) Frames are generated at node A and sent to node C through node B as shown by the diagram below. The data rate between A and B is 100 Kbps, and the propagation delay is 5 μ s/km for both lines. All data frames are 1000 bits long and ACK frames are of negligible size. Between A and B a sliding window protocol with a window size of 3 is used. Between B and C stop-and-wait is used. The transmission medium is assumed to be error free.

Determine the minimum data rate required between nodes B and C so that the buffers of node B are not flooded.



[5]

f) What is a Virtual Private Network (VPN), and how does it provide secure communication over the Internet?

[4]

QUESTION 5

a) Given the IP address **AC10E681** in hexadecimal, give it in the normal dotted decimal notation.

[2]

b) Distinguish between TCP and UDP, indicating where it is suitable to use one over the other.

[5]

c) What is a socket in TCP/IP?

[3]

d) Describe how DNS works.

[3]

e) Describe two protocols that are involved when sending and receiving electronic mail.

[6]

f) What is the difference between secret key cryptography and public key cryptography?

[2]

g) Explain how an application that uses only a web browser for input and output could be setup to allow access to information stored in a database management system.

[4]