UNIVERSITY OF ESWATINI

Faculty of Science & Engineering

Department of Computer Science

MAIN EXAMINATION DECEMBER 2019

Title of Paper: COMPUTER NETWORKS I

Course Number: CSC431/CS437

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 (25 Marks Each).

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QUESTION 1

A) State any 3 reasons why we use the layered structure of computer networks?   [3]

B) What is the difference between a protocol, a service and an interface?   [3]

C) Identify the layers of the OSI reference model where the following would be used;

- Frame sequence number
- MLT-3 encoding
- IP protocol version number
- TCP header length
- Encryption
- Destination port   [7]

D) What is a network topology? Describe different types of network topology with diagrams.   [7]

E) Contrast virtual circuits and datagrams [2]

F) Distinguish between simplex, half-duplex and duplex communication.   [3]

QUESTION 2

A) Distinguish between bit rate and baud rate.   [2]

B) Briefly explain why digital rather than analogue transmission is favoured in modem communication systems.   [4]

C) Draw diagrams showing the encoding of the bit stream 100001110 by;

i) Bipolar encoding

ii) Manchester encoding

iii) Differential Manchester encoding

State all assumptions used.   [6]

D) Given the constellation diagram below, how many different amplitudes and phase shifts does the diagram have? [6]
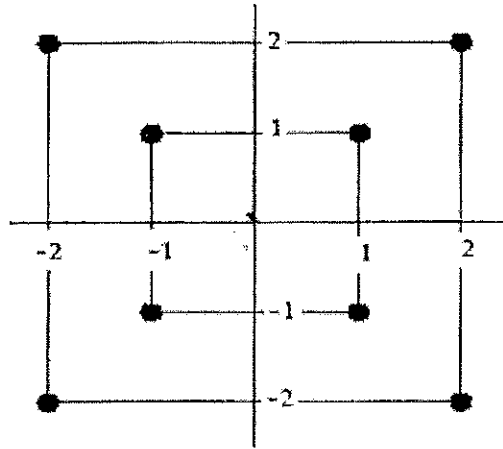
E) How many bits are transmitted per baud? [3]

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]

QUESTION 3

A) Describe Pulse Code Modulation (PCM) and explain why it is used in Public Switched Telephone Networks. [8]

B) An image is 1024 x 768 pixels with 3 bytes/pixel. Assume the image is uncompressed. How long does it take to transmit 10 images over 1-Mbps cable modem? [4]

C) For sliding window protocols, what is?

   i.   Sender Window
   ii.   Sender Window size
   iii.   Receiver Window   [3]

D) Why is slotted Aloha more efficient than pure Aloha? [2]

E) Cyclic Redundancy Checks (CRCs) are used to detect errors in longer messages. If the generator polynomial, G(x), used is: $x^5 + x^4 + x^2 + 1$ and the data to be transmitted, M(x), is 1001101100. Determine the frame, **T(x)** that will be transmitted. [8]

QUESTION 4

A) Automatic Repeat Request (ARQ) protocols aim to provide a Connection Oriented style service based on simple services providing only framing. "Go-back-N" and "Selective Retransmissions" are two such ARQ protocols.

     i) Give illustrated examples of how Go-back-N and selective retransmissions work.
     ii) Briefly discuss the relationship between sequence numbers and window sizes in ARQ protocols.
     iii) Explain the concept of Piggybacking.   [8]

B) In an Ethernet using CSMA/CD protocol, when two nodes transmit at the same time, a collision happens. Can you explain how they resolve this collision? Please justify your answer. [4]

C) Consider the use of 512 bytes frames on a 1 Mbps satellite channel with a 270ms delay. What is the maximum link utilization for stop-and-wait flow control? Acknowledgement frames are 40 bytes. [4]

D) Given that the speed of light is 3×10^8 m/s. A satellite is at geosynchronous orbit. How long would it take for a signal to go from the earth station to the satellite (minimum time)? Assume that the distance of the satellite from the earth (ground) is 35863km. [6]

E) If the characters **A B C DLE STX DLE EXT Z R DLE QLE E** are subjected to character stuffing, what is the output after stuffing? [3]

QUESTION 5

A) What is the Medium Access Control (MAC) protocol? Describe the operation of the CSMA/CD medium access protocol. [5]

B) A 1km long, 10 Mbps CSMA/CD LAN has a propagation speed of 2×10^8 m/s. Data frames are 256 bits long, including 32 bits of header, checksum, and overhead. The first bit slot after a successful transmission is reserved for the receiver to capture the channel to send a 32 bit acknowledgement frame. What is the effective data rate, excluding overhead, assuming that there are no collisions? [4]

C) Draw a diagram for the IEEE 802.3 frame. If the total length of the frame is 1000 bytes, show the actual values of the fields that can be deduced from this information. Explain your answer.

[6]

D) The Hamming Code computes the codeword that uses the least number of check bits to correct single bit errors. Give the formula that gives the relation between the number of check bits used for a given data word. Find the Hamming Code for the bit string **10100111.** Odd parity is used for the check bits. [4]

E) Define channel bandwidth and channel capacity.

[4]

End of Question Paper