UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

SUPPLEMENTARY EXAMINATION JULY 2018

Title of Paper: NETWORKS AND CODING THEORY I

Course Number: 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) Name and briefly describe the layers of the OSI model. Include in your description the process of how data is encapsulated and decapsulated. **[15]**

b) What is a computer network? Describe the 2 ways in which networks are classified. **[6]**

c) Distinguish between bandwidth, bit rate and baud rate **[4]**

QUESTION 2

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

b) Describe the main problems preventing signals from being accurately transmitted through the medium. **[12]**

c) Draw diagrams showing the encoding of the bit stream 10000111 by;

i) Bipolar encoding
ii) Manchester encoding
iii) Differential Manchester encoding

State all assumptions used. **[6]**

d) Briefly explain why digital rather than analogue transmission is favoured in modern communication systems. **[4]**

QUESTION 3

a) Suppose you have a channel from 10000 Hz to 22000 Hz with SNR of 18 dB. Assuming you can achieve about $^1/_3$ of the Shannon's limit;

i) What is the data rate of your channel and
ii) How many signal elements/levels should you use? **[7]**

b) What is multiplexing and why is it commonly carried out in communications networks? Describe frequency division multiplexing and time division multiplexing indicating what type of signal used in each type of multiplexing. **[7]**

c) Explain the concept of bandwidth and how it limits the baud rate. Explain how the baud rate and the bit rate relate. What will limit the maximum bit rate you can achieve? **[7]**

d) What happens in CSMA/CD when a node detects that its data has suffered a collision? **[4]**

QUESTION 4

a) The network operator in Swaziland, SPTC, is promoting ADSL as a network access technology for providing Internet access to the home. With regard to this context, explain what is meant by term 'asymmetric' and why is it suited to accessing the world wide web. State the main limitation of ADSL. **[6]**

b) 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) Briefly describe the following techniques:
   i) Phase Shift Keying (PSK) **[4]**
   ii) Pulse code modulation (PCM) **[4]**

d) "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. **[6]**

QUESTION 5

a) A person on a bicycle travelling at 50 km/hr can carry 5 DVDs, each DVD containing **4.7 GB** (1GB $=2^{30}$ bytes) of data. For what range of distances would it be faster to use the person on the bicycle to transfer the information on 5 DVDs, than to use a **25 Mbps** (lMbps = 10^6 bps) data line to transfer the data? **[5]**

b) 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]**

c) Describe the MAC protocol of the IEEE 802.3 LAN, and mention what makes it more efficient than the ALOHA protocol. **[6]**

d) A 1 Km 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? **[3]**

e) Suppose nodes A and B are on the same 10 Mbps Ethernet segment and the propagation delay between the two nodes is 290 bit times. Suppose node A transmits a 72 byte frame and before it finishes, node B begins transmitting a frame. Show that A will transmit the entire frame before it detects a collision and discuss the consequences. **[3]**

f) 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. **[4]**

End of Question Paper