DATA COMMUNICATION – EDA415

Final Exam 23 May 2000, 14.15 – 18.15 in MG

Examinator:

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Questions:

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Allowable means of assistance:

Only writing tools and accessories, word lists and dictionaries are allowed.

Content:

The final exam consists of 4 (four) pages (including cover), containing 7 problems worth a total of 60 marks.

Grading:

24–35 $\Rightarrow$ 3
36–47 $\Rightarrow$ 4
48–60 $\Rightarrow$ 5

Solution:

Available Wednesday May 24, 9.00 on the department notice board as well as on the web page of the course.

Results:

Available Tuesday May 31, 9.00 on the department notice board.

Questions concerning grading: Tuesday May 31, 13.00-14.00, ED-huset, room 6340.

Language:

The assignment is written in English. You may write your solution in either English or Swedish.

Important Issues

1. Justify all answers. Lack of justification can lead to loss of credit even if the answer might be correct.
2. Explain all calculations thoroughly. If justification and method is correct then simple calculation mistakes does not necessarily lead to loss of credit.
3. If some assumptions in a problem are missing or you consider that the made assumptions are unclear, then please state explicitly which assumptions you make in order to find a solution.
4. Write clearly. If I cannot read your solution, it is wrong.

Good Luck!

Problem 1

Determine whether the following statements are true or false. Each correct answer gives 1 mark, each wrong answer gives -1 mark, each unanswered question gives 0 marks. The total score of this problem cannot be less than zero. (6 marks)

a) A Nyquist pulse shape for transmission is strictly bandlimited and therefore also strictly time limited.

b) A smaller minimum distance between signal points leads to a smaller symbol error rate.

c) For a selective repeat ARQ protocol with b bits sequence numbers, the sliding transmission window size N must be $N \leq 2^b - 1$.

d) An ARP request message in the Internet contains the transmitter's IP address, and data link address as well as the receiver's IP address.

e) In the transport layer, connection is established between two stations using TSAP's.

f) A hash function can be used to provide user authentication in data communication.

Problem 2

a) Why are error and flow control functionalities conducted both in the data link layer and the transport layer? (1 mark)

b) What sort of addressing is used during connection setup in the transport layer? (1 mark)

c) How is a connection terminated in the transport layer? Discuss the relevant issues and describe a practical solution. (3 marks)

d) How are error control and flow control implemented in TCP? (3 marks)

Problem 3

a) Explain the concept of Hamming distance. (1 mark)

b) What is the minimum Hamming distance of a block code? Based on the minimum distance, discuss how many errors the code can correct, respectively, detect. You must justify your answer. Feel free to use figures to assist your arguments. (3 marks)

c) A CRC code is defined by a generator polynomial $g(x) = x^4 + x + 1$. How many CRC bits does that correspond to per codeword? We wish to transmit the 6-bit message 100111. Determine the corresponding codeword. (3 marks)

d) Explain how error detection decoding is done for CRC codes. (1 mark)

Problem 4

a) Explain the differences between CSMA/CD and CSMA/CA. You may use examples and/or figures to illustrate you discussion. (2 marks)

b) In the ethernet a 1-persistent CSMA/CD scheme is specified. Explain how this scheme works. Feel free to illustrate your explanation with figures. (3 marks)

c) In the ethernet the bit rate is 10 Mbps and the minimum packet length is 64 bytes. Why is that? Assuming a system defined margin of zero, what is the corresponding propagation delay? (3 marks)

Problem 5

a) Explain, using a figure for illustration, the general principles for an encryption/decryption system. What is the basic principle for the design of modern crypto systems? (2 marks)

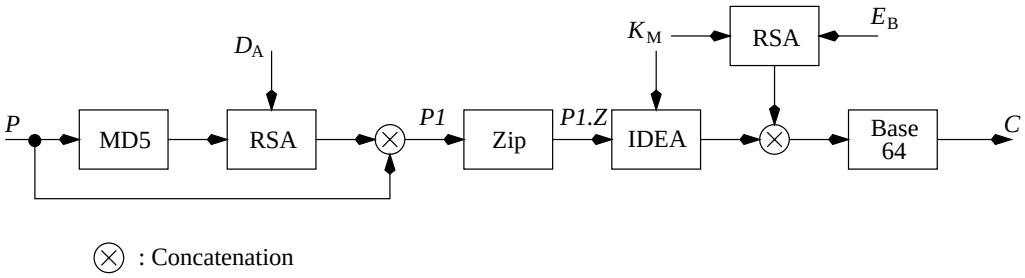
b) You have agreed to use a transposition cipher when communicating with your friend. The key is **SOUTH PARK** and you receive

diiratgmcmesfystnheaesgkiretctaoipsw

What is the message? (2 marks)

c) Explain how public key and secret key crypto systems work. Emphasize the differences between the two. Name one well-known system from each category (3 marks)

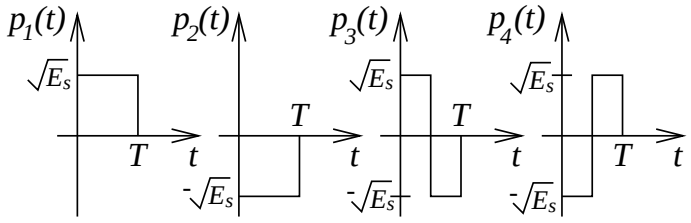
d) Below is a block diagram of the PGP package for secure email on the Internet. Explain, step-by-step, how the message P from Alice gets encrypted into C intended for Bob. (3 marks)



Problem 6

a) What is the fundamental principle in the physical layer when transmitting information symbols over a communication link? (1 mark)

b) Consider the following 4 signal waveforms. What is the corresponding signal space representation? Justify your answer with analytical arguments. (3 marks)



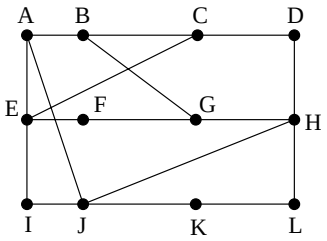
c) Based on the 4 signal waveforms above, how can you obtain an 8-ary signal constellation where each signal alternative has the same energy E_s? (4 marks)

d) Assuming symbol-by-symbol detection, what parameter is most significant for determining the symbol error performance when transmitting over an AWGN channel? Feel free to illustrate your answer with a figure. (2 marks)

Problem 7

a) Describe (preferably with a figure) the layer models based on OSI, TCP/IP and ATM. Relate the description to the model used in the course and discuss differences. (2 marks)

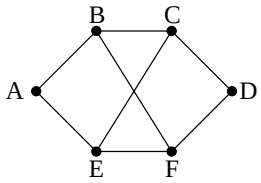
b) Distance vector routing is used in the network below. Determine the new routing table for node J based on the information received from its neighbours. What are the fundamental problems with distance vector routing? (4 marks)



	A	I	H	K
A	0	24	20	21
B	12	36	31	28
C	25	18	19	36
D	40	27	8	24
E	14	7	30	22
F	23	20	19	40
G	18	31	6	31
H	17	20	0	19
I	21	0	14	22
J	9	11	7	10
K	24	22	22	0
L	28	33	9	9
	JA delay 8	JI delay 10	JH delay 12	JK delay 6

vectors received from J's four neighbours

c) Link state routing is an alternative strategy which is used in the network below. Determine the updated routing table for node F based on the exchanged link stage packets. What is the main differences between distance vector routing and link state routing? (2 marks)



A	
Seq	
Age	
B	4
E	5

B	
Seq	
Age	
A	4
C	2
F	6

C	
Seq	
Age	
B	2
D	3
E	1

D	
Seq	
Age	
C	3
F	7

E	
Seq	
Age	
A	5
C	1
F	8

F	
Seq	
Age	
B	6
D	7
E	8

Link state packets

d) Explain the general principles in a computer network firewall. (2 marks)
