Chair of Distributed Systems and Security
School of Computation, Information and Technology
Technical University of Munich

Esolution
Sticker will be generated

Compliance to the code of conduct
I hereby assure that I solve and submit this exam myself under my own name by only using the allowed tools listed below.

_____
Signature or full name if no pen input available

Computer Networking and IT Security

Exam:	INHN0012 / Quiz 1	**Date:**	Thursday 21st November, 2024
Examiner:	Prof. Dr.-Ing. Stephan Günther	**Time:**	16:30 – 16:45

Working instructions

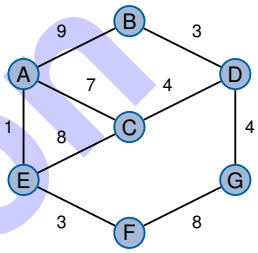
- This exam consists of **4 pages** with a total of **2 problems**.
  Please make sure now that you received a complete copy of the exam.
- The total amount of achievable credits in this exam is 15 credits.
- Detaching pages from the exam is prohibited.
- Allowed resources:
  - **open book**
  - **any teamwork, copy & paste, or AI-based assisstance forbidden**
- **Answers are only accepted if the solution approach is documented.**
- Subproblems marked by * can be solved without results of previous subproblems. Give a reason for each answer unless explicitly stated otherwise in the respective subproblem.
- Do not write with red or green colors nor use pencils.

Problem 1 Multiple Choice (4 credits)

The following subproblems are multiple choice / multiple answer, i. e. at least one answer per subproblem is correct. Subproblems with a single correct answer are graded with 1 credit if correct. Those with more than one correct answers are graded with 1 credit per correct answer and -1 credit per wrong answer. Missing crosses have no influence. The minimal amount of credits per subproblem is 0 credits.

Mark correct answers with a cross ☒
To undo a cross, completely fill out the answer option ■
To re-mark an option, use a human-readable marking ×■

a)* Which edges are contained in a *Minimum Spanning Tree* of the graph shown on the right side?



☐ (F, G) ☒ (C, D) ☒ (B, D) ☒ (A, E) ☐ (A, B) ☒ (G, D)

b)* Which edges are contained in a *Shortest Path Tree* of the graph shown on the right side with root note *G*?

☒ (B, D) ☐ (E, C) ☐ (A, C) ☒ (E, A) ☐ (B, A)

c)* Mark all codewords that have a Hamming distance of three or more from the codeword `0011`.

☐ `0000` ☒ `1100` ☐ `1111` ☐ `0001` ☐ `1001` ☒ `1110`

Problem 2 Short questions (11 credits)

0 1

a)* What is a low-pass filter?

A channel or filter that attenuates low frequncies stronger.

0 1

b)* What is source coding?

Removing of (unstructured) redundancy (lossless compression)

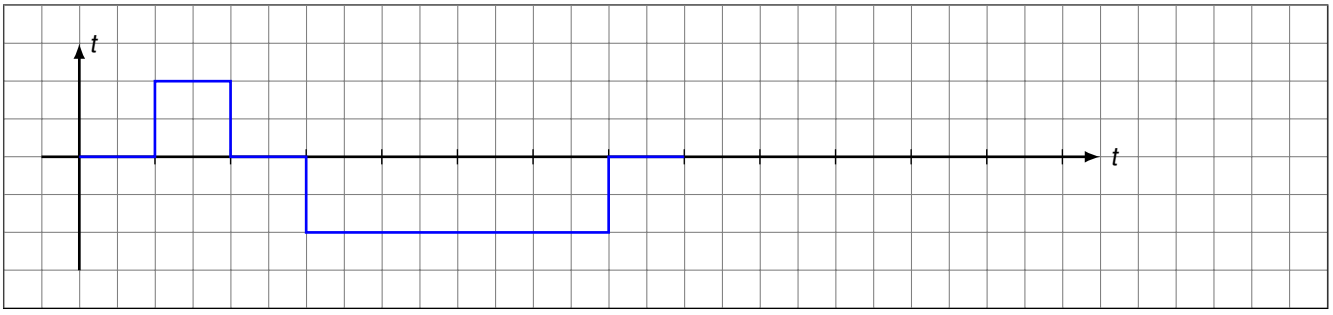
0 1

c)* Explain an advantage of STP over UTP Ethernet cables.

STP has better shielding over external influences.
UTP is more flexible (mechanical) and cheaper.

0 1 2

d)* Given the binary message `0111 0001`. Draw the resulting signal if MLT-3 is being used as line code.



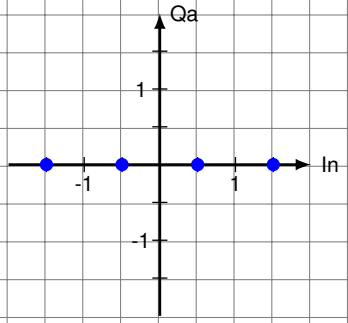
e)* Given a copper cable based medium of length 36 m. Determine the propagation delau.

0 1

$$t_p = \frac{d}{\nu c} = \frac{36\,\text{m}}{\frac{2}{3} \cdot 3 \cdot 10^9\,\text{m/s}} \approx 18\,\text{ns}$$

f)* Give an example of a constellation diagram that is **uniquly** ASK and **cannot** cannot be missunderstood as another one.

0 1



g)* Given a channel of bandwidth 25 MHz. Determine the SNR in dB such that a data rate of 62 Mbit/s is possible.

0 1 2

$$r = B \log_2(1 + \text{SNR}) \Rightarrow \text{SNR} = 2^{(r/B)} - 1 \approx 6.61\,\text{dB}$$

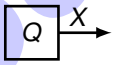
h)* What is the difference between Space- and Frequencymultiplex?

0 1

Multiplexing defines the how a medium is being shared between nodes. Time multiplex assigns time slots for unique transmitters, space multiplex uses multiple (different) channels, and frequency multiplex splits the channel by modulation.

i)* Determine the entropy of the source Q that always repeats the sequence printed below. Reason by words or calculation.

0 1



ABCABB ABCABB ABCABB ... $\quad X \in \{A, B, C\}$

Since always the same sequence is being repeat, the entropy is zero.

Additional space for solutions–clearly mark the (sub)problem your answers are related to and strike out invalid solutions.