RWTH AACHEN UNIVERSITY

Lehrstuhl für Theoretische Informationstechnik

Homework 8 in Cryptography I

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Exercise 23. There are four so called *weak* DES keys. One of those is the key

$$K = 00011111\ 00011111\ 00011111\ 00011111\ 00001110\ 00001110\ 00001110\ 00001110.$$

What happens if you use this key? Can you find the other three weak keys?

Exercise 24. A block cipher is a cryptosystem where plaintext and ciphertext space are the set $\mathcal{A}^n$ of words of length n over an alphabet $\mathcal{A}$. The number n is called the block length.

Show that the encryption functions of block ciphers are permutations. How many different block ciphers exist if $\mathcal{A} = \{0, 1\}$ and the block length is $n = 6$?

Exercise 25. Consider the following AES-128 key given in hexadecimal notation:

$$K = 2d\ 61\ 72\ 69\ 65\ 00\ 76\ 61\ 6e\ 00\ 43\ 6c\ 65\ 65\ 66\ 66$$

a) What is the round key K_0?

b) What are the first 4 bytes of round key K_1?

Exercise 26. Within the step `MixColumns` of the AES algorithm a vector $\mathbf{r}$ is given by $\mathbf{r} = \mathbf{Tc}$ with $\mathbf{c} = (c_0, c_1, c_2, c_3)'$, $c_i \in \mathbb{F}_{2^8}[x]$, and

$$T = \begin{pmatrix} x & (x+1) & 1 & 1 \\ 1 & x & (x+1) & 1 \\ 1 & 1 & x & (x+1) \\ (x+1) & 1 & 1 & x \end{pmatrix}.$$

Show $(c_3u^3 + c_2u^2 + c_1u + c_0)((x+1)u^3 + u^2 + u + x) = r_3u^3 + r_2u^2 + r_1u + r_0 \mod u^4 + 1$.