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## Coding Theory / Discrete Mathematics II

### Assignment 10 (July 13, 2006)

(This assignment is due on July 20, 2006, 1.00 p.m., by dropping it into the wooden box  
in front of F 310)

#### Exercise 1 (Generator matrix):

We consider the code  $C = \{v_1, \dots, v_n\}$  and identify the codewords with vectors. A generator matrix for this code can be obtained by computing a basis for the set of vectors, e. g. one can build a matrix  $A$  with rows  $v_1, \dots, v_n$  and apply elementary row operations to it in order to obtain as many zero rows as possible. Let  $B$  be the resulting matrix. The submatrix (of  $B$ ) consisting of all nonzero rows is the generator matrix.

- (a) Find a generator matrix for the code  $C = \{0000, 1110, 0111, 1001\}$ .
- (b) Find a generator matrix for the code  $C = \{00000, 11100, 00111, 11011\}$ .

(30 Points)

#### Exercise 2 (Parity-check matrix):

The parity-check matrix  $H$  for a code can be obtained from the generator matrix  $G$  in the following way: Bring  $G$  into the form  $G = (I \ X)$ , where  $I$  is the identity matrix and  $X$  the matrix consisting of all other columns (you are allowed to use elementary row operations and to exchange columns). Define  $H = \begin{pmatrix} X \\ I \end{pmatrix}$ .

- (a) Find a parity-check matrix for the code with generator matrix  $G = \begin{pmatrix} 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 \end{pmatrix}$
- (b) Find a parity-check matrix for the code  $C = \{0000, 1001, 0110, 1111\}$ .

(30 Points)