

Name/Code:

1. (20p)	2. (20 p)	3. (20 p)	4. (20 p)	5. (20 p)	Total (100p)	Grade
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- **Apart from the test questions (where each correct answer must be indicated by a tick) each problem must be worked out on a separate sheet on which your name and code must be clearly indicated!**
- **The notations and conventions you use must be conform with the ones used in the lecture series !**
- **Each solution requires a compact reasoning. Without this reasoning the answer is not considered to be valid even though the final result is correct.**

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1. Given a cyclic RS code over GF(8) with a generator polynomial  $g(x) = x^2 + y^4x + y^3$ 
  - a) What are the parameters of the code  $C(n,k)$ ?
  - b) How many errors can this code correct ?
  - c) What is the degree of the parity check polynomial ?
  - d) By what architecture the encoding can be carried out ?
2. Indicate the correct statements by a tick !
  - a) The generator polynomial of a  $C(n,k)$  cyclic code divides the polynomial  $x^n - 1$ .
  - b) Having two error vectors belonging to the same syndrome vector, we must decide on the one which has smaller weight than the other.
  - c) A  $C(7,4)$  binary linear code can qualify for being a Hamming code.
  - d) The last  $k \times k$  segment of the parity check matrix of a systematic linear binary code is the identity matrix.
  - e) Division among polynoms can be implemented on linear feedforward shift registers..
3. Given a memoryless source with the following distribution  $p_1 = 0.7; p_2 = 0.2; p_3 = 0.1$ 
  - a) What is the theoretical limit of compression ! (4p)
  - b) Compress the source by Huffman coding: give the code and the average code length ! (4p)
  - c) What is the average code-length if we compress the source by Shannon-Fano coding? (4p)
  - d) What blocklength should be chosen if the theoretical lower bound is to be achieved with  $\epsilon = 0.002$  . (4p)
  - e) What is then the size of the code table? (4p)
4. Give the answers by a writing the appropriate value !
  - a) Between which min. and max. values bound the entropy of a source containing 4 symbols ?
  - b) What is the optimal length of the codewords in the case of a source with 8 symbols emitted by uniform distribution ?
  - c) Given a source with 5 symbols the corresponding code-lengths of which are  $l_1 = 1; l_2 = 2; l_3 = 2; l_4 = 3$ . At least what should be the code-length associated with the 5<sup>th</sup> symbols ?
  - d) What is the joint entropy of two binary, independent, uniformly distributed random variables ?
  - e) Give the channel capacity of BSC with bit error probability 0.5 !
5. Depict the shift register architecture of multiplying an arbitrary element  $\alpha = a_2y^2 + a_1y + a_0 \in GF(8)$  with 4 in GF(8).

Elégtelen	Elégséges	Közepes	Jó	Jeles
0-39 pont	40-53 pont	54-67 pont	68-81 pont	82-100 pont