Surname, Name, Matr. (ID): ..... Signature: .....

Answer to the questions carefully, and according to the order assigned in the text. An answer consisting of ONLY FEW LINES of text will be considered NOT sufficient. If the hand written text and the general organisation of the answers on the paper will not be CLEANLY and CLEARLY written, and therefore difficult to be properly read and interpreted, the answer would NOT BE TAKEN into account in the final evaluation.
Any NOT GIVEN or COMPLETELY WRONG answer will be taken into account negatively (i.e., producing a penalty (negative marks)) in the overall evaluation.

Part1 (Exercises on Error Control Codes)

1. A (7,4) linear block code is described by the generator polinomial $g(D) = D^3 + D + 1$. Indicate the values assumed by the "sindrome" associated to a possible single bit error, a possible two bits error, a possible three bits error. In case of 1 error, how many different sindromes are possible ?

2. A block code with $N = 7$ is characterized by the generator polynomial: $g(D) = (D + 1)(D^3 + D + 1)$. Determine the minimum distance of this code. Is this code a cyclic code ? Determine the number of possible codewords, the error probability in case of both hard (use the more precise estimation) and soft decoding.

3. Consider a convolutional code with $R = 1/2$, and octal generators $(7, 5)$.
   - Draw the tree diagram of the code.
   - Determine the code word associated to the information sequence 010101100, and the minimum bandwidth required in case of an information bit-rate equal to 10 Mbit/sec.
   - Determine and draw the trellis diagram of the code.

Part2 (Modulation systems)

1. Basic Theory
   - Define the concept of "complex envelope" and describe the major equations related to this concept.
   - Considering PAM base-band modulation, describe the Nyquist pulses and the role of the roll-off parameter.
2. OFDM
   - Discuss about the main advantages and problems of the OFDM modulation systems.
   - Describe in some detail the channel equalization procedure used in the OFDM modulation systems, indicating the role of the cyclic prefix and of the pilot carriers.
3. DSSS
   - Define the m-sequences and describe why this seq. are used in the DSSS modulation.
   - Describe the basic ideas used in the CDMA systems, giving also an idea about its performances.
4. CPM
   - Describe the analytical expression of the modulated signal in case of MSK modulation.
   - Describe the analytical expression of the likelihood function that should be maxi-mized by the optimal receiver in the case of MSK modulation.
5. Turbo-LDPC Codes
   - Describe the curves that represents the performance (P(E) as a function of Eb/No) of a turbo code, indicating the role of the iterations, and the role of the inter-leaver.
   - Describe the basic idea and the motivations of the EXIT charts.