Telecom Network Systems (SRT)
Regular exam
16/06/2015 16:30-19:30
(Duration: 3 hours)

MIEET 4º ano

- Write your name, student number and course on all sheets you hand in.
- Talking is not allowed. If you do it, your exam will be canceled. Switch off your cellular telephone.
- If you give up, write “I Desist” on the exam sheet and hand it in.
- The exam has 7 questions and the maximum score for each is written in brackets.
- Write legible.
- Good luck!

Question 1 (2)
What is the Nyquist rate for signals? (Give and describe 2 formulas).

Question 2 (2)
What is ISO and the ISO.OSI model?

Question 3 (5)
Imagine we have 101 coins and we know that one of them is false. With two (2) measurements we want to determine if the coin is lighter or heavier. Note that it is not needed to say *which* one it is. Make a decision diagram and calculate the relevant Shannon Entropies and amount of information retrieved.

Question 4 (4)
For channel coding of binary-symmetric data, we can use R^5, namely simply sending the encoded bit 5 times and use majority-vote as channel decoding algorithm. If a bit in the noisy channel has an error of 0.01 (1%) to arrive wrong on the other side, what is the final bit-error rate of the communication?

Question 5 (3)
Explain the forward-error correction (FEC) method “7.4 Hamming”. When do we need FEC?

Question 6 (2)
Calculate the capacitance of a coax cable with inner-core diameter a_0 and outside shield diameter a_1. Maxwell's Equations and Divergence Theorem given in annex.

Question 7 (2)
Explain what is ergodicity.

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Maxwell's Equations :

Maxwell's Equations

$\nabla \times \bar{E} = -\partial \bar{B} / \partial t$	I
$\nabla \times \bar{H} = \partial \bar{D} / \partial t + \bar{J}$	II
$\nabla \cdot \bar{D} = \rho$	III
$\nabla \cdot \bar{B} = 0$	IV
$\bar{B} = \mu \bar{H}$	V
$\bar{D} = \varepsilon \bar{E}$	VI

Divergence Theorem : For any vector field $\bar{F}$:

$$\oiiint \nabla \cdot \bar{F} \, dv = \oiint \bar{F} \cdot \bar{n} \, ds$$