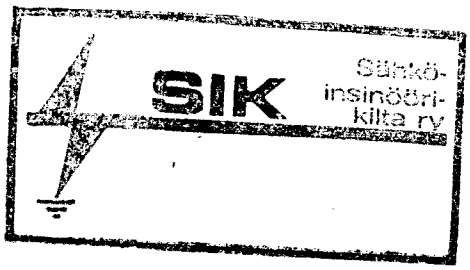
OULUN YLIOPISTO

Tietoliikennelaboratorio



TELECOMMUNICATION THEORY

Final exam 11.05.2004

1. Answer briefly but punctually on the following questions; employ diagrams and/or formulas to clarify your answer, if possible (1 p/item):
   a) matched filter
   b) quadrature multiplexing
   c) Shannon-Hartley's law
   d) equivocation
   e) entropy
   f) detection gain

2. a) Explain the structure of AM modulator and demodulator. Draw the block diagram of transmitter and receiver. Sketch roughly a time waveform of the AM modulated signal. (3 p)

   b) Explain the structure of superheterodyne receiver. What are the benefits of its use? For which purpose it is needed? (3 p)

3. a) Explain what is the preemphasis-deemphasis technique (i.e. what it deals with). How is it implemented? What is gained with it? (4 p)

   b) What is the *threshold effect*? Describe, in which cases it appears (i.e. for which modulations and receiver structures it appears)? Clarify your answer with the aid of a simplified signal phasor (vector) presentation. (2 p)

4. a) Describe the structure of DPSK modulator and demodulator (3 p)

   b) Describe PCM principle. How it is implemented? (3 p)

5. a) What is an equalizer? For which purpose it is used? Tell briefly how it is implemented? (3 p)

   b) Explain the basic principle behind phase-locked loop (PLL). What are the basic building blocks of PLL and how it works? For which purpose PLLs are needed? (3 p)

$\sin(u \pm v) = \sin(u)\cos(v) \pm \cos(u)\sin(v)$
$\cos(u \pm v) = \cos(u)\cos(v) \mp \sin(u)\sin(v)$
$\sin(u)\sin(v) = [\cos(u-v) - \cos(u+v)]/2$
$\cos(u)\cos(v) = [\cos(u-v) + \cos(u+v)]/2$
$\sin(u)\cos(v) = [\sin(u-v) + \sin(u+v)]/2$
$\cos^2(u) = [1 + \cos(2u)]/2$
$\sin^2(u) = [1 - \cos(2u)]/2$
$\sin(2u) = 2\sin(u)\cos(u)$, $\cos(2u) = \cos^2(u) - \sin^2(u)$
$\cos(u) = (e^{ju} + e^{-ju})/2$, $\sin(u) = (e^{ju} - e^{-ju})/2j$, $e^{\pm ju} = \cos(u) \pm j\sin(u)$