Konstantin.rykov@tut.fi

TLT-5206 COMMUNICATION THEORY 2nd Mid-term exam 08.12.2011

(*Suomenkieliset kysymykset toisella puolella*) Basic calculator allowed. Prepared by J. Talvitie.

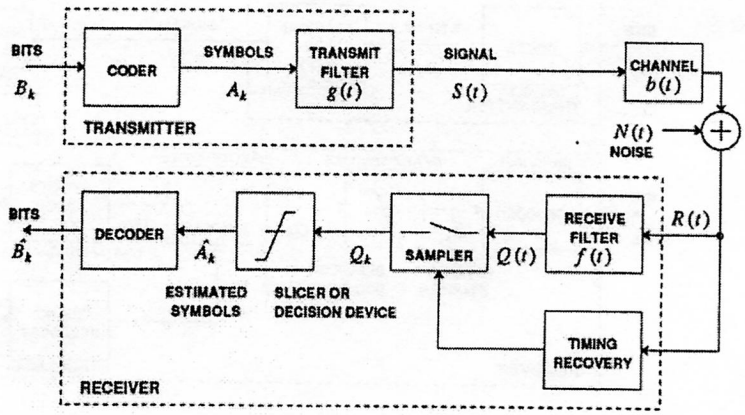
1. Explain shortly the following concepts: *a)* Instantaneous frequency *b)* Raised-cosine pulse *c)* Symbol constellation *d)* Information *e)* Entropy *f)* Channel capacity

2. *a)* Explain briefly the basic idea of frequency modulation (FM). Sketch also the essential waveform shape and spectrum of the modulated signal (at principal levels) when the modulating signal is a single sine-wave (frequency f_M). What advantages does FM generally have compared to linear modulation methods? (4p)

   b) Depict (draw) the conceptual post-detection noise power density spectrum of FM signal. Based on this, explain the principle of pre-emphasis/de-emphasis filtering. Is it possible to affect channel interference based issues with pre-emphasis/de-emphasis filtering in case of FM, why?

3. Present the time domain mathematical model for ideal sampling process. Given the spectrum of a continuous-time signal, sketch (i.e., draw) also the corresponding spectrum after ideal sampling. Based on that, formulate the basic requirement in order to avoid aliasing. Explain also the basic idea of reconstruction both in time and frequency domains. What is the fundamental difference between a discrete time signal and a digital signal?

4. In the figure below a block diagram of a baseband digital transmission system based on Nyquist pulse shaping is presented. Describe briefly the fundamental purpose/meaning of each block in the system (1-3 sentences per block). To which blocks the terms symbol alphabet and pulse shape are related and how they affect the system performance (bit rate, noise sensitivity, bandwidth, etc.)?



5. Let's consider a carrier-modulated digital PAM/PSK/QAM system where the target bit rate is 25 Mbits/s and the available transmission bandwidth around the center-frequency is 15 MHz. Design the system at waveform level, i.e., determine reasonable values for the key parameters (symbol rate, alphabet size, excess bandwidth, etc.). Explain the thinking behind your design using written text and/or figures (So, just presenting the calculations is not enough)

Maximum points: 5 x 6 = 30p.