Aalto University School of Science and Technology
Exam May 20th, 2010
Department of Signal Processing and Acoustics
S-88.3105 Digital Signal Processing Systems (5 cr)

Write in each answer paper your name, department, student number, the course name and code, and the date. Number each paper you submit and denote the total no. of pages. 4 problems, 30 points total. Exam problems in English only. Please feel free to answer in Finnish or English. No additional material is allowed in the exam.

1. (8p) Explain *briefly* the following concepts:

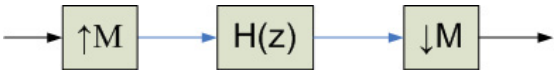
(a) Half-band filter Decimation filter

(b) Difference of Type I and Type II polyphase decomposition

(c) Tree-structured filter bank

2. (4p) Consider the four block diagrams below. Which blocks are equivalent and which are not?

3. (8p) Consider the fractional sampling rate converter below, where the greatest common denominator between up-sampling and down-sampling factors is given by $\gcd(L, M) = N > 1$.



Explain step-by-step by drawing block diagrams how this system can be transformed into a computationally efficient sampling rate converter.

4. (10p) Show that a perfect reconstruction linear-phase filter bank with causal filters must be such that $H_0(z)H_1(-z)$ ($H_0(z)$ and $H_1(z)$ are the analysis filters) has an odd number of coefficients and that all but one of its odd powers of z must be zero.