

**SGN-4010 Puheen käsittelyn Menetelmät**  
**Speech Processing Methods**  
exam 1.2.2007

You may answer either in Finnish or English.

**Problem 1.** Explain briefly what the following terms mean (1 point/term):  
a) unit selection synthesis, b) simple inverse filter tracking (SIFT), c) formant bandwidth (formantin kaistanleveys), d) discrete-time Fourier transform (DTFT), e) harmonic spectrum (harmoninen spektri), f) frame (kehys).

**Problem 2.**

a) What 3 properties can be used to classify how vowels are produced (eli minkä ominaisuuksien perusteella vokaalit voidaan luokitella)? (3 points)

b) What 3 properties can be used to classify how consonants are produced (sama kysymys konsonanteille)? (3 points)

**Problem 3.** The FFT of the signal [15 4 0 1 0 4] is [24 18 12 6 12 18]. Draw a sketch (hahmotelma) of the FFT of the signals

a) [15 4 0 1 0 4 0 0 0 0 0 0 0 0 0 0]. (2 points)

b) [15 4 0 1 0 4 15 4 0 1 0 4 15 4 0 1 0 4]. (2 points)

**Problem 4.** The samples  $x(k)$  of a short frame of speech are

$k$	0	1	2	3	4	5	6
$x(k)$	1	3	2	-2	0	2	1

a) What is the autocorrelation function for this frame? (1 point)

b) What is the optimal 1<sup>st</sup>-order prediction-error filter (eli optimaalinen ensimmäisen asteen ennustusvirhesuodatin)? (1 point)

c) What is the energy of the prediction error with the optimal 1<sup>st</sup>-order prediction-error filter (tätä vastaava ennustusvirheen energia)? (1 point)

d) What is the energy of the prediction error with the optimal 3<sup>rd</sup>-order prediction error filter? (kolmannen asteen ennustusvirheen energia)? (2 points)

e) What are the reflection coefficients  $k_1, k_2, k_3$  (heijastuskertoimet)? (2 points)