USN | | | | | | | | | | |

10EC123

M.Tech. Degree Examination, January 2013

Modern DSP

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Given $x(t) = 3\cos(1000\pi t - 0.1\pi) - 2\cos(1500\pi t + 0.6\pi) + 5\cos(2500\pi t + 0.2\pi)$, find the Nyquist sampling frequency and express x(t) in terms of x(n). **(05 Marks)**

b. State and sketch the Fourier transform of a sampled signal band limited to F_0 HZ. **(05 Marks)**

c. Draw a block diagram of a DELTA modulation scheme and explain it. **(05 Marks)**

d. Assume ideal band limited filter F_B, sampling frequency F_S, signal maximum range V_{MAX}, quantization Q bits. Derive the error variance at the output. **(05 Marks)**

2 a. State the DFT and IDFT and its properties. **(10 Marks)**

b. Explain the design of an IIR digital filter using Butterworth analog filter. **(10 Marks)**

3 a. State the general form of state space equation for implementation of a digital filter. **(04 Marks)**

b. Given $H(z) = \dfrac{2z^2 - z + 1.5}{z^2 - 1.6z + 8}$. Draw a block diagram indicating states and derive state space equation. **(06 Marks)**

c. Draw a block diagram of Lattice implementation of FIR filter and state its transfer function. **(05 Marks)**

d. Given $H(z) = 1 - 1.4z^{-1} + 0.26z^{-2} + 1.544z^{-3} - 0.576z^{-4} - 0.4147z^{-5}$, determine the reduced polynomial $A_4(z)$. **(05 Marks)**

4 a. State time domain formulas foe upsampler and downsampler and derive z transforms. **(12 Marks)**

b. Explain how a signal sampled at $f_s = 10$ kHz can be resampled at $f_s = 22$ kHz using Fourier transfer and block diagrams. **(08 Marks)**

5 a. State the noble identities and explain implementation of efficient multirate filters using noble identity and polyphase decomposition. **(08 Marks)**

b. Obtain the output z transform Y(z) in Fig.Q5(b). **(04 Marks)**

Fig.Q5(b)

c. Obtain the output z transform Y(z) in in Fig.Q5(c). **(04 Marks)**

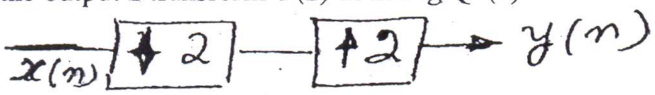

Fig.Q5(c)

d. Determine the polyphase decomposition for

$M = 2;\quad H(z) = \dfrac{z}{z - 0.8}$

$M = 3;\quad H(z) = 1 + 2z^{-1} + 3z^{-2} + 4z^{-3} + 5z^{-4} + 6z^{-5}$ **(04 Marks)**

6 a. Obtain the block diagram of a DFT-M channel analysis filter bank using polyphase decompition of a prototype filter H(z). **(10 Marks)**

b. Determine the polyphase decomposition for M = 4 of an ideal filter with cut-off frequency $\omega_c = \frac{\pi}{4}$ and number of terms $-5 \leq M \leq 5$. **(10 Marks)**

7 a. Draw the block diagram of n^2 channel PR scheme and state the filter relationship. **(10 Marks)**

b. Determine the analysis filter $\tilde{G}(z^{-1})$ given synthesis filter $G(z) = 1 + 2z^{-1} + z^{-2}$. **(05 Marks)**

c. Draw a single lattice unit of an orthonormal filter bank and prove that PR orthonormal conditions are met. **(05 Marks)**

8 a. Let W(t) be a window. Find the STFT of $x(t) = \delta(t - T_0)$. **(04 Marks)**

b. Let W(t) be a window. Find the STFT of $x(t) = e^{-j2\pi F_0 t}$. **(04 Marks)**

c. Explain discrete time wavelet decomposition using dual basis vectors and their interpretation as filter banks. Show how two channel PR maximally decimated filter banks can be used to implement this interpretation. **(12 Marks)**

*****