

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007

Fifth Semester

Electronics and Communication Engineering

EC 333 — DIGITAL SIGNAL PROCESSING

(Common to B.E. Biomedical Engineering)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the properties of convolution.
2. How can you find step response of a system if the impulse response $h(n)$ is known?
3. Give the equation for the order N , major, minor and axis of an ellipse in case of chebyshev filter.
4. Write the magnitude function of Butterworth filter. What is the effect of varying order of N on magnitude and phase response?
5. Mention the necessary and sufficient condition for linear phase characteristics in FIR filter.
6. For what type of filters frequency sampling method is suitable?
7. What do you understand by A/D conversion noise?
8. Draw the probability density function for rounding.
9. Give the expression for signal to quantization noise ratio and calculate the improvement with an increase of 2 bits to the existing bit.
10. What do you mean by sub-band coding?

PART B — (5 × 16 = 80 marks)

11. (i) Determine the frequency response $H(e^{j\omega})$ for the system and plot magnitude response and phase response $y(n) + \frac{1}{4}y(n-1) = x(n) - x(n-1)$. (10)

(ii) Check whether the following systems are linear and time invariant. (2)

(1) $y(n) = nx(n)$

(2) $y(n) = ux^2(n)$.

12. (a) Design a chebyshev type 1 band reject filter with the following specifications.

Pass band dc to 275 Hz and 2kHz to ∞ stop band 550Hz to 1000Hz.

$\alpha_p = 1dB$ $\alpha_s = 15dB$ $f_s = 8kHz$

Or

(b) (i) Using the bilinear transform design a high pass filter, monotonic in passband with cut off frequency of 1000Hz and down 10dB at 350Hz. The sampling frequency is 5000 Hz. (10)

(ii) Design a third order Butterworth digital filter using impulse invariant technique. Assume sampling period T = 1 sec. (6)

13. (a) Design an ideal differentiator with frequency response $H(e^{jw}) = jw$ $-\pi \leq w \leq \pi$ using

(i) Rectangular window

(ii) Hamming window with N = 7. Plot frequency response in both cases.

Or

(b) (i) Design a FIR filter approximating the ideal frequency response.

$$H_d(e^{jw}) = \begin{cases} e^{-j\omega} & \text{for } |w| \leq \frac{\pi}{6} \\ 0 & \text{for } \frac{\pi}{6} \leq |w| \leq \pi \end{cases} \quad (10)$$

Determine the filter co-efficients for N = 13.

(ii) Determine the frequency response of FIR filter defined by $y(n) = 0.25x(n) + x(n-1) + 0.25x(n-2)$. Calculate the phase delay and group delay. (6)

14. (a) (i) For the given transfer function $H(z) = H_1(z)H_2(z)$ where $H_1(z) = \frac{1}{1-0.5z^{-1}}$ and $H_2(z) = \frac{1}{1-0.4z^{-1}}$, find the output round off noise power. Calculate the value if b = 3 (excluding sign bit). (9)

(ii) Repeat the above problem if the system is realized in direct form. (7)

Or

- (b) (i) Find the effect of coefficient quantization on pole locations of the given second order IIR system when it is realized in direct form I and in cascade form. Assume a word length of 4 bits through truncation.

$$H(z) = \frac{1}{1 - 0.9z^{-1} + 0.2z^{-2}} \quad (3)$$

- (ii) Explain the characteristics of a limit cycle oscillation with respect to the system described by the difference equation.

$$y(n) = 0.95y(n-1) + x(n)$$

Determine the dead band of the filter. (3)

15. (a) Explain sampling rate reduction by an integer factor 'D'. Derive input and output frequency spectra relation.

Or

- (b) (i) What do you understand by QMF filter? Explain its operation in detail. (8)
- (ii) Explain on principle of Multirate DSP. (8)