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B.E/B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL/MAY 2012
ELECTRONICS AND COMMUNICATION ENGINEERING
FIFTH SEMESTER (REGULATION 2008)
EC 9304 – DIGITAL SIGNAL PROCESSING

Time : 3 Hrs   Max. Mark :100

Answer <u>ALL</u> Questions

PART-A **(10 x 2 = 20 Marks)**

1. Determine whether the signal $\cos(0.01\pi n)$ is periodic and if periodic, then compute the fundamental period.
2. Define Twiddle factor and mention it's properties.
3. Find the transfer function for normalized Butterworth filter of order 1 by determining the pole values.
4. Mention the characteristics of a Butterworth filter.
5. What is the condition for the impulse response of FIR filter to satisfy for constant group and phase delay.
6. Obtain the linear phase realization structure given h(n) = {1,4, 3,4,1}
7. How will you avoid limit cycle oscillations due to overflow in addition?
8. Give the equation of Hamming window.
9. What is the necessity for sampling rate converters in signal processing?
10. What is an anti-imaging filter and where it is used?

PART-B **(5 x 16 = 80 Marks)**

11.(i) Explain the decimation of sampling rate by an integer factor 'D' and derive the spectra for decimated signal. (10)

(ii) Obtain the polyphase decomposition structure for a 6-tap FIR filter with a decomposition factor of 2. (6)

12.a)(i) If $x(n) = \partial(n) + 2\partial(n-2) - \partial(n-5)$ has a 10-point DFT X(k), find the inverse DFT of (I) Re{X(k)} and (II) Im{X(k)}. (8)

(ii) Compute the four point DFT of the sequence, x(n) = {0,1} using radix-2 DIF-FFT algorithm . Sketch the magnitude and phase spectrum of X(k). (8)

(OR)

12.b)(i) Determine the response of the system with impulse response h(n) ={1,-2} for a lengthy input sequence x(n) = {1, 3, 5, 7, 9, 11, -7, -5, 1} using overlap save method. (8)

(ii) Starting from the basic principles, derive the equations and draw the basic butterfly pattern for inplace radix-2 decimation in time FFT algorithm to compute a 8 – point DFT. (8)

13.a) Design and realize a digital Butterworth filter satisfying the constraints

$$0.707 \le |H(e^{j\varpi})| \le 1 \quad , \text{for } 0 \le \varpi \le \pi/2$$

$$|H(e^{j\varpi})| \le 0.2 \quad , \text{for } 3\pi/4 \le \varpi \le \pi.$$

With T = 1 sec using Impulse Invariance Method. (16)

(OR)

13.b) Using the bilinear transformation, design a highpass filter, monotonic in passband with cutoff frequency of 1000 Hz and down 10dB at 350Hz. The sampling frequency is 5KHz. Realize the transfer function of the designed filter. (16)

(P.T.O)

14.a) Determine the filter coefficients h(n) and transfer function H(z) for the filter of length M=15 obtained by sampling its frequency response as

$$H\left[\left(2\pi/15\right)k\right] = \begin{cases} 1, & k = 0, 1, 2, 3, 4 \\ 0.4, & k = 5 \\ 0, & k = 6, 7 \end{cases}$$

(16)

(OR)

14.b) Design a high pass filter using blackman window with a cutoff frequency of 1.2 radians and N=7. Also realize the obtained transfer function. (16)

15.a)(i) Draw the quantization noise model for a second order system given by $H(z) = 1 / (1 - 2 r \cos\theta\, z^{-1} + r^2 z^{-2})$ and find the steady state output noise variance. (10)

(ii) Write short notes on "Saturation Arithmetic". (6)

(OR)

15.b)(i) Two first order low pass filters with system function, $H_1(z) = 1/(1-0.9z^{-1})$ and $H_2(z) = 1/(1-0.8z^{-1})$ are connected in cascade. Determine the overall noise power. (8)

(ii) Explain in detail about instruction pipelining with an example. (8)