CRASH COURSE

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10TE52

# Fifth Semester B.E. Degree Examination, May 2017
## Digital Signal Processing

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

### PART – A

1 a. Consider a finite length sequence $x(n) = \delta(n) + 2\delta(n-5)$. Find
   i) The 10 point DFT of x(n)
   ii) Find the sequence that has a DFT $y(k) = e^{\frac{j2\pi 2k}{10}} x(k)$
   iii) Find the 10 point sequence y(n) that has DFT y(k) = x(k) w(k), where x(k) is the 10 point DFT of x(n) and w(k) is the 10 point DFT of w(n) given by $w(n) = \begin{cases} 1 & 0 \le n \le 6 \\ 0 & \text{otherwise} \end{cases}$ **(12 Marks)**

   b. Find the DFT of the sequence $x(n) = 0.5^n u(n)$ for $0 \le n \le 3$ by evaluating $x(n) = a^n$ for $0 \le n \le N-1$. **(08 Marks)**

2 a. Consider a FIR filter with impulse response $h(n) = \{3, \underset{\uparrow}{2}, 1, 1\}$. If the input is x(n) = {1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1} find the output using overlap add method, assuming the length of block as 7. **(12 Marks)**

   b. State and prove the following properties i) Linearity ii) Circular time shift. **(08 Marks)**

3 a. What are FFT algorithms? Prove the i) symmetry and ii) periodicity property of the twiddle factor $W_N$. **(07 Marks)**

   b. What are the advantages of FFT algorithm? **(04 Marks)**

   c. Use the 8 point radix- 2 DIT FFT algorithm to find the DFT of the sequence X(n) = {0.707, 1, 0.707, 0, -0.707, -1, -0.707, 0}. **(09 Marks)**

4 a. Develop decimation in frequency (DIF)-FFT algorithm with all necessary steps and neat signal flow diagram used in computing N-point DFT, x(k) of a N point sequence (x(n)). **(12 Marks)**

   b. What is Goertzel algorithm? For sequence x(n) = (2, 0, 2, 0) determine x(2) using Goertzel algorithm. Assume initial conditions are zero. **(08 Marks)**

### PART – B

5 a. Design a Chebyshev I filter to meet the following specifications **(12 Marks)**
   i) Passband ripple : ≤ 2dB
   ii) Passband edge : 1 rad/sec
   iii) Stopband attenuation : ≥ 20dB
   iv) Stopband edge : 1.3 rad/sec

   b. Derive the expression for order and cutoff frequency of a Butterworth low pass filter. **(08 Marks)**



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6 a. A liner time invariant digital IIR filter is specified by the following transfer function

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left[z-\left(\frac{1}{2}+j\frac{1}{2}\right)\right]\left[z-\left(\frac{1}{2}-j\frac{1}{2}\right)\right]\left[z-j\frac{1}{4}\right]\left[z+j\frac{1}{4}\right]}$$

Realize the system in the following forms i) direct form I ii) direct form II **(12 Marks)**

b. Realize an FIR filter with impulse response h(n) given by $h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-u)]$ using direct form I. **(08 Marks)**

7 a. Obtain the 10 coefficients of an FIR filter to meet the specifications given below using Hamming window method **(12 Marks)**

| | | |
|---|---|---|
| Passband edge frequency | : | 1.5 KHz |
| Stopband edge frequency | : | 2 KHz |
| Minimum stopband attenuation | : | 50 dB |
| Sampling frequency | : | 8 KHz |

b. Derive the frequency response of a symmetric FIR low pass filter for both N even and N odd. **(08 Marks)**

8 a. Show that the bilinear transformation maps
   i) The jΩ axis in s-plane onto the unit circle, $|z| = 1$
   ii) The left half S plane, $Re(S) < 0$ inside the unit circle, $|z| < 1$. **(10 Marks)**

b. A digital lowpass filter is required to meet the following specifications
$20 \log |H(w)|_{w = 0.2\pi} \geq -1.9328$ db
$20 \log |H(w)|_{w = 0.6\pi} \leq -13.9794$ dB
The filter must have a maximally flat frequency response. Find H(z) to meet the above specifications using impulse invariant transformation. **(10 Marks)**

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