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Total number of printed pages – 3

B. Tech
PCEC 4304

Sixth Semester Back Examination – 2015

DIGITAL SIGNAL PROCESSING

BRANCH : EEE

QUESTION CODE : M 237

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any five from the rest.
The figures in the right-hand margin indicate marks.*



1. Answer the following questions :

2×10

(a) Use Delay and advance element to realize the following transfer function.

$$H(z) = \frac{1+z}{1+z^2}$$

(b) State initial value theorem of Z-transform.

(c) What is approximate transition width of main lobe in the rectangular window ? What happens to it if you double the filter length ?

(d) How many real multiplication and real additions are required to compute 16 point DFT ?

(e) Find out the magnitude of transfer function of the system whose impulse response is described as

$$H(z) = \frac{1}{1+z^2}$$

(f) Under what conditions the pair of zeros of FIR filter will be complex conjugate ?

(g) What is linear phase ? Under what condition an FIR filter become linear phase ?

(h) What do you mean by frequency warping in digital filter ? How this effect can be eliminated ?

(i) What is circular convolution ?

(j) State and proof linearity property of DFT.

P.T.O.

2. (a) Consider the LTI system described by the equation 4
 $x(n] = p^n u(n - 1) - q^n u(-n)$
 What conditions must hold on p and q for Z-transform to exist.
- (b) Find Z-transform of 6
 (a) $x(n] = n^2 \delta(n)$
 (b) $x(n] = nu(n + 1)$
3. (a) Find 4-point IDFT of the signal, $X(k] = \{1, 1, 0, 1\}$ and sketch magnitude response. 5
- (b) The DFT of $x(n]$ is described as $X(k] = \{1, -1 + 2j, -1, 1 + 2j, \}$. Find the DFT of $x^2(n]$. 5
4. (a) Convert the analog filter with system function
- $$H(s) = \frac{s+1}{(s+1)^2 + 16}$$
- Into a digital IIR filter using bilinear transformation. The digital filter is to have a resonant frequency of $\omega_r = \pi/2$. 5
- (b) State the difference between IIR and FIR filter. 5
5. (a) Derive two conditions that must be fulfilled for FIR filter to behave as linear phase. 5
- (b) Consider the casual system
 $Y(n] = 0.75y(n - 1) - 0.125y(n - 2) + x(n] + 0.25x(n - 2)$
 Obtain parallel structure of the system. 5
6. Determine the coefficient of linear phase FIR filter length $M=15$, which has a symmetric unit sample response and frequency response that satisfies the condition 10

$$\begin{aligned} H_r\left(\frac{2\pi K}{15}\right) &= 1 & K = 0, 1, 2, 3 \\ &= 0.4 & K = 4 \\ &= 0 & K = 5, 6, 7 \end{aligned}$$

7. (a) Explain Decimation in time FFT algorithm 5
(b) Determine pole- zero plot for the discrete signal 5

$$x(n) = a^n \quad 0 \leq n \leq M - 1$$
$$= 0 \quad \text{otherwise}$$

Where, $a > 0$

8. Write short notes on any **two** : 5×2

- (a) System Modeling
(b) Overlap add method in linear filtering
(c) Stability of LTI system
(d) Windows used in designing FIR filter.

