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BT-6 / M-18

DIGITAL SIGNAL PROCESSING

Paper–ECE–302N

Time allowed : 3 hours] *[Maximum marks : 75*

Note :- *Attempt any five questions. Selecting at least one question from each unit.*

Unit–I

1. (a) State and prove the correlation property of Z-transform. 7

(b) Determine the inverse z-transform of the sequences system function $H(z) = \frac{1}{(z-1)(z-0.8)}$

For the following ROC, determine the stability of the system: 8

(i) $|z| > 1$

(ii) $|z| < 0.8$

(iii) $0.8 < |z| < 1$

2. (a) State and prove that a causal LTI-system is BIBO stable if and only if its impulse response is absolutely summable. Assume system is initially relaxed. 7

(b) Explain the Chirp Z- transform algorithm for linear filtering approach. 8

Unit–II

3. (a) Given $x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\}$ and $N = 8$, then find $X(k)$ using Radix -2 DIF FFT algorithm. 8

(b) Give the comparison between FIR and IIR systems. 7

4. (a) Explain the lattice structure for a FIR- system. 8

(b) Develop the direct form-I and form-II for the IIR system given by $y(n) = 2b \cos(w_o)\, y(n-1) - b^2 y(n-2) + x(n) - b \cos(w_o)\, x(n-1)$ 7

Unit–III

5. (a) Define window function. Derive an expression for frequency response of a rectangular window function. 8

(b) Find the magnitude and phase response of the linear phase FIR filter, when its impulse response is symmetric. 7

6. (a) A low pass filter is to be designed with the following desired frequency response

$$H_d(e^{jw}) = e^{-j2w} \; ; -\pi/4 \leq w \leq \pi/4$$
$$0 \; ; \text{otherwise}$$

Determine the filter coefficients $h_d(n)$ if the window function is defined as

$$w(n) = 1 \; ; 0 \leq n \leq 4$$
$$0 \; ; \text{otherwise}$$

Also, determine the frequency response $H(e^{jw})$ of the desi filter. 10

(b) Explain the Gibbs phenomenon and its consequences. 5

Unit–IV

7. (a) Convert the analog filter into a digital filter whose system function is given by

$$H_a(s) = \frac{1}{(s+2)(s+1)}$$

Then determine corresponding H (z) using impulse invariance Transformation method and sampling time period T = 0.2 second. 6

(b) Explain the Bilinear transformation method of IIR filter design. 9

8. (a) Design a digital Butterworth filter that satisfies the following constraint using impulse invariant transformation.

$0.5 \leq |H(e^{jw})| \leq 1 \quad ; 0 \leq w \leq \pi/2$

$|H(e^{jw})| \leq 0.2 \quad ; 3\pi/4 \leq w \leq \pi$

Assume T = 1.0 Second. 12

(b) Give the comparison between the impulse invariance and bilinear transformation. 3