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BT-6/M-20 **36108**

DIGITAL SIGNAL PROCESSING
Paper–ECE-302 N

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *five* questions in all taking at least *one* question from each unit.

UNIT–I

1. (a) Determine z-transform of the following signals :

(i) $x(n) = \frac{1}{2}(n^2 + n)\left(\frac{1}{3}\right)^{n-1} u(n-1)$.

(ii) $x(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-10)]$. 6

(b) Determine transient and steady state responses of the system characterized by difference equation $y(n) = 0.5y(n-1) + x(n)$, when input signal is $x(n) = 10 \cos\left(\frac{\pi n}{4}\right) u(n)$. Assume system to be at rest initially. 9

2. (a) Determine causal signal $x(n)$ having z-transform

$$X(z) = \frac{1}{(1-2z^{-1})(1-z^{-1})^2}.$$ 6

(b) For a system function $H(z) = \dfrac{1}{1 - \frac{7}{4}z^{-1} - \frac{1}{2}z^{-2}}$, test stability using Schur-Cohn stability criterion. Also, write the algorithm. 6

(c) Write a short note on all pass filters. 3

UNIT–II

3. (a) Obtain circular and linear convolution for the sequences $x_1(n) = [5 \quad 3 \quad -4]$ and $x_2(n) = [2 \quad -1 \quad 6]$. 7

(b) Obtain the DFT with the help of Butterfly diagram of the sequence $[1 \quad 1 \quad 3 \quad 3 \quad 1 \quad 1 \quad 2 \quad 2]$. 8

4. (a) State and prove the properties of linearity and symmetry for DFT. 5

(b) Consider the fourth order transfer function of IIR filter $H(z) = \dfrac{2z(z^3 + 1)}{[(z + 0.3)^2 + 0.16](z - 0.8)(z + 0.7)}$. Realize it by (i) Paraller form realization and (ii) Cascade form realization. 10

UNIT–III

5. State and prove special characteristics of FIR filters? Give its types and explain them in detail. 15

6. (a) Write short note on Kaiser window method for designing FIR filter. 8

(b) What do you understand by Gibb's phenomenon? Explain with the help of an illustrative example. 7

UNIT–IV

7. (a) What are the advantages and disadvantages of bilinear transformation? 6

(b) Use bilinear technique to determine the order and cut-off frequency of a low-pass Butterworth digital filter to give response of 3 dB or less for frequencies up to 2 kHz and attenuation of 20 dB or more beyond 4 kHz. 9

8. Write short notes on :

(a) Chebyshev filter. 7

(b) Elliptical analog filter. 8

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