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MT / D–13

DIGITAL SIGNAL PROCESSING

Paper–MTEC–1.2

Time allowed : 3 hours] *[Maximum marks : 60*

Note : *Solve any **five** questions, by selecting at least **one** from each unit.*

Unit–I

1. Determine whether the following systems are

(i) Static or dynamic

(ii) Linear or non-linear

(iii) Causal or non-causal

(iv) Stable or unstable 3,3,3,3

(a) $y(n) = \cos[x(n)]$

(b) $y(n) = \sum_{n=-\infty}^{n+1} x(k)$

(c) $y(n) = x(2n)$

(d) $y(n) = x(-n)$

2. (a) Determine and sketch the convolution of the following signals 5

$$x(n) = \begin{cases} \frac{1}{3}n, & 0 \le n \le 6 \\ 0, & \text{otherwise} \end{cases}$$

$$h(n) = \begin{cases} 1, & -2 \le n \le 2 \\ 0, & \text{elsewhere} \end{cases}$$

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(b) Without using any transform ; determine the response $y(n)$; $n \geq 0$, of the system described by the difference equation. 7

$$y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$$

Unit–II

3. (a) Define Z-transform and explain importance of the ROC. 2

(b) Determine Z-transform of the signal 6

$$x(n) = (-1)^{n+1} \cdot \frac{a^n}{n} u(n-1)$$

(c) State and prove Parseval's theorem 4

4. (a) State and prove final value theorem related with Z-transform. 5

(b) Determine

(i) impulse response

(ii) Zero state step response and

(iii) Step response if $y(-1) = 1$ and $y(-2) = 2$, for the system 7

$$H(z) = \frac{z^{-1} + \frac{1}{2} z^{-2}}{1 - \frac{3}{5} z^{-1} + \frac{2}{25} z^{-2}}$$

Unit–III

5. (a) Derive an interpolation formula to obtain spectrum $X(w)$ of signal $x(n)$ from samples $X(k)$ or $X(w)$. 8

(b) Compute four point DFT of the sequence $x(n) = (1, 2, 3, 4)$. 4

6. (a) State and prove symmetry properties of DFT. 6

(b) Prove that multiplication of two DFTs lead to circular convolution of the corresponding time domain signals. 6

Unit–IV

7. Explain in detail the characteristic of the following filters

(a) Butterworth filter 5

(b) Chebyshev Type-I filter. 7

8. (a) Obtain the direct form II and cascade structures for the system

$$H(z) = \frac{2(1 - z^{-1})(1 + \sqrt{5} z^{-1} + z^{-2})}{(1 + 0.5 z^{-1})(1 - 0.9 z^{-1} + 0.81 z^{-2})}$$ 6

(b) Convert the analog filter with the system function

$$Ha(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9}$$

into digital IIR filter by mean of impulse invariance method. 6