

M.E. First Semester (Electrical Engg. (Electrical Power System))  
**13570 : Digital Signal Processing and Applications : EP 2103**

P. Pages : 3

Time : Three Hours



AW - 3862

Max. Marks : 80

- Notes : 1. Answer **three** question from Section A and **three** question from Section B.  
 2. Assume suitable data wherever necessary.  
 3. Use of pen Blue/Black ink/refill only for writing the answer book.

**SECTION – A**

1. a) Find the solution of difference equation

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$$y(n) + \frac{1}{2}y(n-1) - \frac{1}{4}y(n-2) = 0$$

$$y(-1) = y(-2) = 1$$

- b) A signal  $x(t)$  is sampled at frequency  $\omega_0$ , find the sampling rate of following signals to avoid aliasing.

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$$\text{i)} \quad y(t) = x(t) + x(t-1)$$

$$\text{ii)} \quad y(t) = \frac{dx}{dt}$$

$$\text{iii)} \quad y(t) = x^2(t)$$

$$\text{iv)} \quad y(t) = x(t) * x(t)$$

**OR**

2. a)  $x(n) = [1, 2, 4, \underset{\uparrow}{-1}, 2, 3]$

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plot following signals

$$\text{i)} \quad x(2n+1)$$

$$\text{ii)} \quad x(-n+3)$$

$$\text{iii)} \quad x\left(\frac{n}{2}\right)$$

$$\text{iv)} \quad x(-n-4)$$

- b) Obtain convolution of following signals.

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$$x(n) = (0.5)^{n-2} u(n-2)$$

$$h(n) = u(n+2)$$

3. Determine whether systems defined by following equations are static/dynamic, linear/Nonlinear, TIV/TV, causal, noncausal, stable/unstable

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$$\text{i)} \quad y(n) = x(n) + \frac{1}{x(n-1)}$$

$$\text{ii)} \quad y(n) = |x(n)|$$

$$\text{iii)} \quad y(n) = \text{truncation}[x(n)]$$

$$\text{iv)} \quad y(n) = x(n) \cos \omega_0 n$$

$$\text{v)} \quad y(n) = \text{sgn } x(n)$$

$$\text{vi)} \quad y(n) = x(-2n)$$

**OR**

4. a) Determine all possible signal  $x(n)$  associated with

$$Z.T. \quad x(z) = \frac{5z^{-1}}{(1-2z^{-1})(3-z^{-1})}$$

- b) Find convolution of signal using Z.T.

$$x_1(n) = \left(\frac{1}{4}\right)^n u(n-1)$$

$$x_2(n) = \left(1 + \left(\frac{1}{2}\right)^n\right) u(n).$$

5. a) Consider the signal

$$x(n) = \begin{bmatrix} -1, 2, -3, 2, -1 \\ \uparrow \end{bmatrix}$$

with Fourier transform  $X(w)$ .

compute following Quantities without computing  $X(w)$ .

i)  $X(0)$  ii)  $|X(\omega)|$

iii)  $\int_{-\pi}^{\pi} X(\omega) d\omega$  iv)  $X(\pi)$

v)  $\int_{-\pi}^{\pi} |X(\omega)|^2 d\omega$

- b) Obtain 4 point DFT of signal

$$x(n) = \cos \frac{\pi}{4} n.$$

**OR**

6. a) Using Radix 2 DIT, FFT algorithm obtain 8 point DFT of signal

$$x(n) = [1 \ 1 \ 2 \ 3 \ 4 \ 2 \ 6 \ 2]$$

- b) Obtain convolution using DTFT

$$x(n) = \begin{bmatrix} 2, 1, 3, 4 \\ \uparrow \end{bmatrix}$$

$$h(n) = \begin{bmatrix} 1, 1, 1 \\ \uparrow \end{bmatrix}.$$

## SECTION - B

7. For given specifications design an digital Butterworth filter using BLT for following specifications

$$0.9 \leq |H(\omega)| \leq 1, \quad 0 \leq \omega \leq 0.2\pi$$

$$|H(\omega)| \leq 0.2 \quad 0.4\pi \leq \omega \leq \pi.$$

$$TS = 1.$$

**OR**

8. a) Compare IIR and FIR filter . 6

b) Convert an analog filter with transfer function 7

$$H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16}$$

into digital IIR filter by means of Bilinear transformation. The digital filter is to have a resonant frequency of  $\omega = \pi/2$ .

9. a) Define Multirate systems and sampling rate conversion. 6

b) Discuss the sampling rate conversion by factor I with the help of block diagram. 8

**OR**

10. a) Explain the effect of aliasing in decimation with the frequency spectrum and discuss how aliasing can be eliminated? 8

b) Obtain the necessary expression for interpolation process. 6

11. Explain application of DSP in speech processing. 13

**OR**

12. Explain Application of WSP in Instrumentation. 13

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