B.E. (Information Technology) Semester Seventh (C.B.S.)

Elective - II : Digital Signal Processing

P. Pages : 2 **KNT/KW/16/7507**

Time : Three Hours * 0 8 8 0 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Use of non programmable calculator is permitted.

1. a) Explain the following system properties with example. **7**

i) Linear system ii) Time invariance system

iii) Dynamic system iv) Causal system

b) The analog signal given below is sampled by 600 samples per second **6**

$y(t) = 2\sin(240\pi t) + 3\sin(660\pi t)$

Calculate :

i) Nyquist sampling rate

ii) Folding frequency

iii) Frequencies in radians of y(n)

OR

2. a) Compute the cross correlation of $x_1(n)$ with $x_2(n)$ where **6**

$x_1(n) = \{\underset{\uparrow}{1}, 2, 3, 4\}$

$x_2(n) = \{\underset{\uparrow}{5}, 6, 7, 8\}$

b) Convolve two sequences graphically **7**

$x(n) = \{\underset{\uparrow}{1}, 2, 3, 4\}$

$h(n) = \{1, \underset{\uparrow}{2}, 1, -1\}$

3. a) State and explain any three properties of z-transform. **6**

b) Determine the z-transform of the following finite durations signals. **7**

i) $x_1(n) = \{3, 1, 2, \underset{\uparrow}{5}, 7, 0, 1\}$

ii) $x_2(n) = \delta(n)$

iii) $x_3(n) = \{\underset{\uparrow}{0}, 0, 1, 2, 5, 4, 0, 1\}$

iv) $x_4(n) = \{-1, -2, 0, 1, \underset{\uparrow}{2}\}$

OR

4. a) Determine z-transform of the following infinite duration series **6**

i) $\frac{a^n}{n!}$ ii) $e^{jwn}U(n)$ iii) $\cos(w_n)\cdot u(n)$

b) Determine inverse z-transform of $X(z)=\frac{1}{1-4z^{-1}+3z^{-2}}$ if ROC is : **7**

i) $|z| > 3$ ii) $|z| < 1$

5. a) Determine Fourier transform of the signal $x(n)=a^{|n|}$; $-1<a<1$ **7**

b) State & prove any three properties of DFT. **7**

OR

6. a) Compute the DFT of the sequence x(n) = {0, 1, 2, 1}. Sketch the magnitude and phase spectrum. **7**

b) Perform circular convolution using DFT - IDFT method for **7**

$x_1(n)=\{\underset{\uparrow}{1}, 2, 3, 4\}$

$x_2(n)=\{\underset{\uparrow}{2}, 1, 3, -3\}$

7. a) Convert the analog filter with system function $H_a(s)=\frac{s+0.3}{(s+0.3)^2+25}$ **7**

into a digital IIR filter by means of impulse invariance method.

b) Convert the analog filter with system function $H_a(s)=\frac{2}{(s+3)+(s+1)}$ **7**

into a digital IIR filter by using Bilinear transformation assume T = 0.1 sec.

OR

8. Obtain the direct form - I, Direct form - II cascade & parallel structure for the following system **14**

$$y(n)=\frac{3}{4}y(n-1)-\frac{1}{8}y(n-2)+x(n)+\frac{1}{3}x(n-1)$$

9. Design a filter with $H_d\left(e^{-j\omega}\right)=\begin{cases} e^{-j3\omega} & , -\frac{3\pi}{4}\le\omega\le\frac{3\pi}{4} \\ 0 & , \frac{3\pi}{4}<|\omega|\le\pi \end{cases}$ **13**

Using a Hamming window with M = 7.

OR

10. Using a rectangular window, design a low pass filter with pass band gain of unity, cut off frequency of 1 kHz and working at a sampling frequency of 5 kHz. The length of the impulse response should be 7. **13**

11. Compute 8-point DFT of the sequence x(n) = {1, 2, 3, 4, 3, 2, 1, 0} **13**
Using DIF-FFT algorithm. Show the steps with suitable diagram.

OR

12. Given X(k) = {20, -5.828-j2.414, 0, -0.172-j0.414, 0, -0.172+j0.414, 0, -5.828+j2.414} find inverse DFT using DIFFFT algorithm. **13**

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