B.E. Eighth Semester (Electrical Engineering (Electronics & Power)) (C.B.S.)

Elective - II : Digital Signal Processing

P. Pages : 2 **KNT/KW/16/7572**

Time : Three Hours * 0 3 3 1 * Max. Marks : 80

Notes :
1. Solve Question 1 OR Questions No. 2.
2. Solve Question 3 OR Questions No. 4.
3. Solve Question 5 OR Questions No. 6.
4. Solve Question 7 OR Questions No. 8.
5. Solve Question 9 OR Questions No. 10.
6. Solve Question 11 OR Questions No. 12.
7. Due credit will be given to neatness and adequate dimensions.
8. Assume suitable data whenever necessary.

1. a) Given $x(n)=\left\{1,\underset{\uparrow}{2},3,4,5,6\right\}$ **5**

Plot $x(n-3), x(3-n), x\left(n^2\right), x\left(n/2\right), x(2n)$

b) For the following system, determine whether the system is **8**

i) Dynamic/Static ii) Time variant/ time invariant
iii) Linear / nonlinear iv) Causal /non causal

1) Y (n) = 3 x (n)+5
2) Y (n) = n x(n)

OR

2. a) Compute the linear convolution of the following sequence graphically **7**

$x(n)=\{1,2,3,4\}$ and $h(n)=\{1,-2,3,-4\}$

b) Compute the cross correlation of the following sequences. **6**

$x(n)=\{1,3,5,7\}$ and $y(n)=\{2,4,6,8\}$

3. a) Compute the DTFT of $x(n)=a^n u(n)$ **5**

b) Determine convolution of sequences. **8**

$x_1(n)=x_2(n)=1 \quad \text{for } -2\le n\le 2$

$\qquad\qquad = 0 \quad \text{othewise}$

using DTFT.

OR

4. a) State and prove any three properties of DTFT. **6**

b) Determine energy density spectrum $S_{xx}^{(w)}$ of the signal **7**

$x(n)=a^n u(n), a<1.\text{Sketch}\, S_{xx}^{(w)}$ for $a=0.5$ and -0.5

5. a) State and prove the differentiation and linearity property of Z-transform. **7**

b) Solve the differential equation using Z transform. **7**

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

OR

6. a) Determine the inverse Z-transform of following (by power series expansion) **8**

$$x(z)=\frac{1}{1-1.5z^{-1}+0.5z^{-2}}$$

When (a) ROC :$|z|>1$ (b) ROC :$|z|<0.5$

b) Find z-transform of the following signals: **6**

(i) $x(n) = (1/2)^n u(n+2) + 3^n u(-n-1)$

ii) $x(n) = \delta(n) + \frac{1}{2}\delta(n-3)$

7. A Filter (LTI system) is described by the following difference equation: **13**

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

Implement the system using DF-I, DF-II, cascade and parallel form of structures.

OR

8. a) Evaluate the frequency response of the system described by the system function. **3**

$H(z) = \frac{1}{1-0.8z^{-1}}$

b) Write short note on All-pass filters. **4**

c) Given a three stage lattice filter with coefficients $k_1 = 1/4; k_2 = 1/4, k_3 = \frac{1}{3}$ determine the FIR filter coefficients for the direct form structure. **6**

9. a) Convert the analog filter with system function : **6**

$H(S) = \frac{2}{(S+1)\,(S+3)}$

into a digital IIR filter using bilinear transformation Assume T = 0.15.

b) An analog filter transfer function is given by **8**

$H(S) = \frac{1}{(S+3)\,(S+5)}$

Obtain transfer function H(z) of IIR digital filter using impulse invariance transformation. Assume T = 0.15. Also draw the realization.

OR

10. a) Compare IIR & FIR filter. **4**

b) Design an IIR filter satisfying the following specification using kaiser window **10**

$\alpha_p \le 0.1\text{dB}$ $\qquad \alpha_s \ge 44.0\text{dB}$

$\omega_p = 20 \text{ rad/sec}$ $\qquad \omega_s = 30 \text{ rad/sec}$

$w_{sf} = 100 \text{ rad/sec}$

11. a) State and prove any two properties of DFT. **4**

b) Compute the circular convolution of the following sequence by DFT/IDFT method : **9**

$x_1(n) = \{1, 2, 3, 4\}$ & $x_2(n) = \{2, 1, 2, 1\}$

OR

12. a) Differentiate between overlap add and overlap save method of filtering. **4**

b) Compute the 8-point DFT of the given sequence using DIT-FFT algorithm. **9**

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

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