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Ist SEMESTER **M.Tech (SPDD-ECE)**

Supplementary Examination **Feb 2019**

EC-521 Advanced DSP

Time : 3Hrs **Maximum Marks: 100**

Note: Attempt any 10 questions. Assume missing data if any.

1 a The output signal of upsampler system is to be passed through Low Pass Filters. Is the statement true ? If true, why? 4

b Consider the sequences 6

i $x_1(n) = 3\delta(n+1) - 2\delta(n) + \delta(n-1) + 4\delta(n-2)$

ii $x_2(n) = \delta(n+2) - \delta(n) + \delta(n-2)$

iii $h_1(n) = 2\delta(n-1) + 5\delta(n-2) + 3\delta(n-3)$

iv $h_2(n) = \delta(n) + \delta(n-1)$

Determine the following sequences obtained by linear convolution of a pair of the above sequences

$y_1(n) = x_1(n) \circledast h_1(n)$

$y_2(n) = x_2(n) \circledast h_2(n)$

2 a The impulse response of a LTI system is h(n) = {1,2,1,-2}. Find response of the system for the input x(n)={1,3,2,1} 5

b Find the inverse Fourier Transform of first order recursive filter $H(\omega) = (1-ae^{-j\omega})^{-1}$ 5

3 Compute the DFT of the 3-point sequence x(n) = {2,1,2}. Using the same sequence compute 6-point DFT and compare two DFTs 10

4 a Let x(n) = {A,2,3,4,5,6,7,B}. If X(0) = 20 and X(4) = 0 find A and B 5

b Consider the length-6 sequence defined for $0 \le n < 6$.

x(n) = {1,-2,3,0,-1,1}

with a 8-point DFT X(k). Evaluate the following functions of X(k) without computing DFT 5

i. X(0)

ii. X(3)

iii. $\sum_{k=0}^{5} X(K)$

iv. $\sum_{k=0}^{5} |X(k)|^2$

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5 Find the circular convolution of the following sequences using DFT and IDFT — 10

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

6 Determine the total solution for $n \geq 0$ of the difference equation — 5

i. $y[n] + 2\,y[n-1] = (n+1)$
with initial condition $y[-1] = 1$ and $y[-1] = 0$

ii. $y(n) + 0.5\,y(n-1) = 2\,u(n)$ — 5
with initial condition $y[-1] = 2$

7 Using properties of Z Transform find the Z-Transform of the following signals — 10

i. $x(n) = u(-n)$
ii. $x(n) = u(-n+1)$
iii. $x(n) = u(-n-2)$
iv. $x(n) = 2^n u(n-2)$
v. $x(n) = \alpha^{n-2} u(n-2)$

8 Find inverse Z Transform of — 10

i. $\frac{z^2+2z}{z^3+3z^2+4z+1}$; ROC $|z| > 1$

ii. $\frac{z^2+z+2}{z^3-2z^2+3z+4}$; ROC $|z| < 1$

9 a A non causal LTI FIR discrete Time system is characterized by an impulse response $h(n) = a_1\delta(n-2) + a_2\delta(n-1) + a_3\delta(n) + a_4\delta(n+1) + a_5\delta(n+2)$. For what value of the impulse response samples will its frequency response $H(e^{j\omega})$ have a zero phase — 5

b A non causal LTI FIR discrete Time system is characterized by an impulse response $h(n) = a_1\delta(n) + a_2\delta(n-1) + a_3\delta(n-2) + a_4\delta(n-3) + a_5\delta(n-4) + a_6\delta(n-5) + a_7\delta(n-6)$. For what value of the impulse response samples will its frequency response $H(e^{j\omega})$ have a linear phase — 5

10 a Show that the 3DB frequency of Low Pass and High pass IIR filter is same. Assume first order LPF and HPF — 5

b Show that ideal filters are not realizable. How can we improve the characteristics of a simple LPF near to characteristics of ideal filter — 5

11 Determine the fundamental period of following periodic sequences — 10

i. $x_1[n] = e^{-j0.4\pi n}$
ii. $x_2[n] = \sin(0.6\pi n + 0.6\pi)$
iii. $x_3[n] = 2\cos(1.1\pi n - 0.5\pi) + 2\sin(0.7\pi n)$
iv. $x_4[n] = 3\sin(1.3\pi n) - 4\cos(0.3\pi n + 0.45\pi)$
v. $x_5[n] = 5\sin(1.25\pi n + 0.65\pi) + 4\sin(0.8\pi n) - \cos(0.8\pi n)$

12 a Let $x_{ev}[n]$ and $x_{od}[n]$ represent even and odd parts of a square summable sequence $x[n]$. Prove the following result — 5

$\sum_{-\infty}^{\infty} x^2[n] = \sum_{-\infty}^{\infty} xev[n]^2 + \sum_{-\infty}^{\infty} xod[n]^2$

b Compute the energy of length N sequence — 5

$X[n] = Cos\left(\frac{2\pi Kn}{N}\right) \quad 0 \leq n \leq N-1$

END