E – 51762

Register No. | | | | | | | | |

BE Degree Examination November 2021

Fifth Semester

Electronics and Instrumentation Engineering

18EIT54 – DIGITAL SIGNAL PROCESSING

(Regulations 2018)

Time: Three hours | Maximum: 100 marks

Answer all Questions

Part – A (10 × 2 = 20 marks)

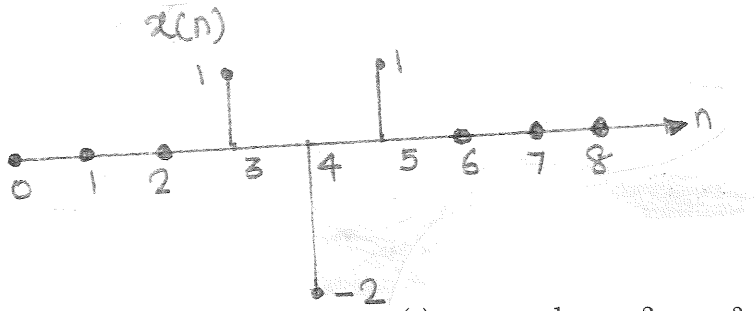
1. State Nyquist samping theorem. [CO1,K1]

2. Plot the signal x(n) and its folded version. The sequence x(n) is defined as [CO1,K2]
$x(n)=\begin{cases}1 & \text{for} \quad n=0,1,2,3\\ 0 & \text{otherwise}\end{cases}$.

3. Determine the transfer function using z – transform, given the input-output relation of the discrete – time system $y(n)=x(n)+y(n-1)$. [CO2,K2]

4. The DFT of a four point sequence $[x_1,x_2,3,4]$is given by $[10,-2+j2,-2,-2-j2]$. Determine the values of $x_1$ and $x_2$. [CO2,K3]

5. The impulse response of the linear phase FIR filter is given below. Determine the group delay of the filter. [CO3,K2]

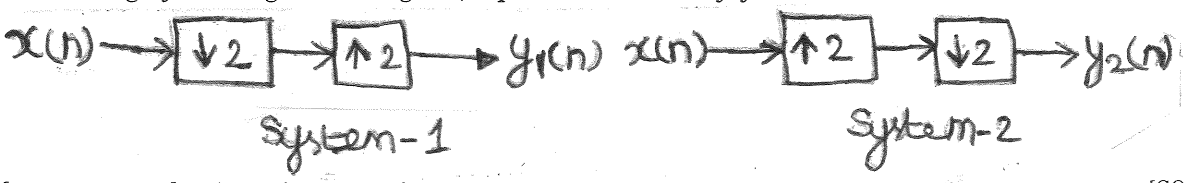



6. An LTI filter has the following transfer function: $H(z)=2+3z^{-1}-4z^{-2}+3z^{-3}-5z^{-4}$. Find the impulse response of the filter. Whether the filter will exhibit linear phase characteristics? [CO3,K2]

7. What do you mean by the term 'Warping' with respect to bilinear transformation? Why does it occurs? [CO4,K2]

8. Represent the direct form – I structure of the system whose transfer function [CO4,K3]
$H(z)=\dfrac{1+0.5z^{-1}}{1-0.1z^{-1}-0.2z^{-2}}$.

9. Are the following systems given in figure, equivalent? Justify your answer. [CO5,K3]




10. Show that up sampler is a time varying system. [CO5,K2]

Part – B (5 × 16 = 80 marks)

11. a. i) For the signal $x(n)=\left\{3,-2,1,\underset{\uparrow}{0},3,2,1\right\}$. Perform the following scaling operations. i) $y_1(n)=2x(n)$, ii) $y_2(n)=\frac{1}{2}x(n)$ iii) $y_3(n)=x(2n)$ iv) $y_4(n)=x\left(\frac{n}{2}\right)$ and shifting operations: v) $y_5(n)=x(n+2)$ (10) [CO1,K3]

ii) The relationship between the input and output of the system is given by $y(n)=n^2x(n)$. Find whether the system is linear, and time invariant. (6) [CO1,K3]

(OR)

b. i) Perform circular convection and correlation between the two sequences $x_1(n)=\{1, 2, 3, 4\}$ and $x_2(n)=\{1, 2, 2, 1\}$ (10) [CO1,K3]

ii) Perform the linear convolution between the two sequences $x(n)=\left\{1, \underset{\uparrow}{2},3\right\}$ and $h(n)=\left\{\underset{\uparrow}{1},-1\right\}$. (6) [CO1,K3]

12. a. An 8 – point sequence is given by $x(n)=\{2, 2, 2, 2, 1, 1, 1, 1\}$. Compute 8 – point DFT of x(n) by radix -2 DIF-FFT. Also sketch the magnitude and phase spectrum. (16) [CO2,K3]

(OR)

b. In as LTI system the input $x(n)=\{1, 1, 1\}$ and the impulse response $h(n)=\{-1, -1\}$. Determine the response of LTI system by radix -2 DIF-FFT. (16) [CO2,K3]

13. a. Design an ideal FIR low – pass filter of length 7 with the following magnitude response: (16) [CO3,K3]

$$H\left(e^{jw}\right)=\begin{cases}1; & \frac{-\pi}{4}\le\omega\le\frac{\pi}{4}\\ 0; & \text{otherwise}\end{cases}$$

. Sketch the impulse response, magnitude and phase response of the filter. Assume the window to be rectangular window.

(OR)

b. Obtain the direct form structure and the linear phase structure of the FIR filter whose impulse response is given by $h(n)=\delta(n)+2\delta(n-1)+2\delta(n-2)+\delta(n-3)$. (16) [CO3,K3]

14. a. i) Obtain the cascade form of realization of the system whose transfer function is given by $H(z)=\dfrac{1-z^{-1}}{\left(1+\frac{1}{4}z^{-}\right)\left(1+\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)}$. (10) [CO4,K3]

ii) Obtain direct form I of the discrete time system represented by the input – output relation $5y(n)+3y(n-1)=2x(n)+6x(n-1)$. (6) [CO4,K3]

(OR)

b. The specification of the desired low pass filter is (16) [CO4,K3]

$$\frac{1}{\sqrt{2}} \le |H(\omega)| \le 1.0; \quad 0 \le \omega \le \frac{\pi}{5}$$

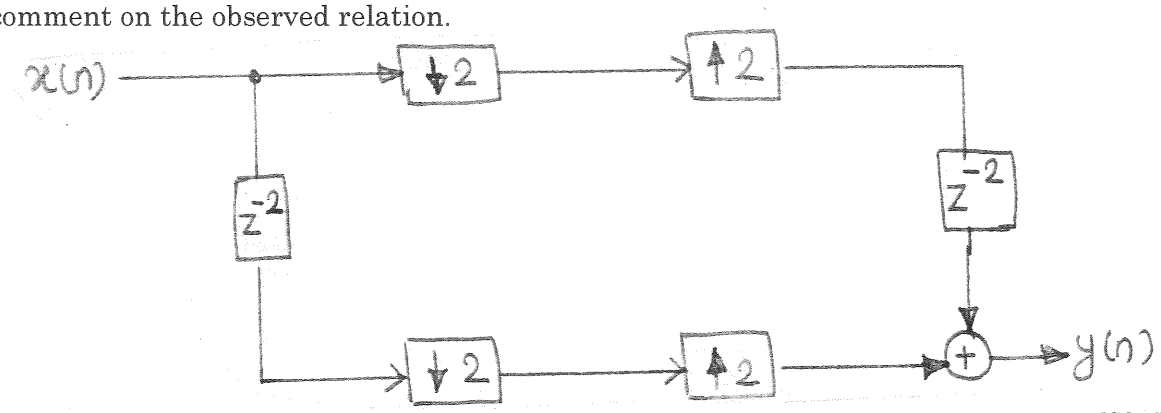
$$|H(\omega)| \le 0.08; \quad \frac{\pi}{2.5} \le \omega \le \pi$$

Design a Butterworth digital filter using bilinear transformation.

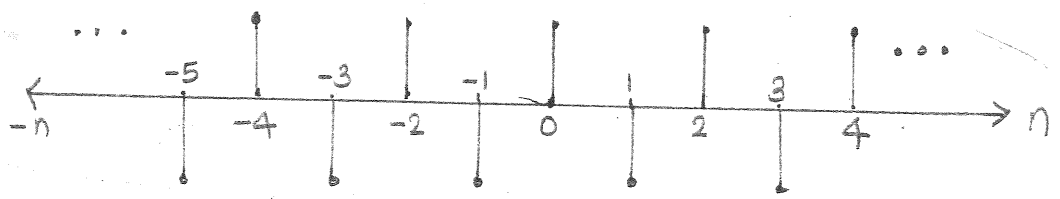
15. a. Draw the architecture of TMS320C54X DSP processor and explain the functioning of each block. Also mention the features of the same. (16) [CO5,K2]

(OR)

b. i) For the system shown below, find the relationship between the output Y(z) and the input X(z), for the time domain input $x(n)=\{\underset{\uparrow}{1}, 2, 3, 4\}$ and comment on the observed relation. (10) [CO5,K3]




ii) The relationship between the input and the output signal is given by $y(n)=x(2n)$. Plot the signal y(n) for the input signal x(n), which is shown below. Comment on the observed result. (6) [CO5,K3]




| Bloom's Taxonomy Level | Remembering (K1) | Understanding (K2) | Applying (K3) | Analysing (K4) | Evaluating (K5) | Creating (K6) |
|---|---|---|---|---|---|---|
| Percentage | 1 | 16 | 83 | - | - | - |