MANIPAL INSTITUTE OF TECHNOLOGY
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V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING) PROCTORED ONLINE MAKEUP EXAMINATIONS, FEBRAUARY 2022

DIGITAL SIGNAL PROCESSING [ELE 3152]

REVISED CREDIT SYSTEM

Time: 75 Minutes + 10 Minutes **Date: 22 February 2022** **Max. Marks: 20**

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Time: 75 minutes for writing + 10 minutes for uploading.

1A. A finite support signal $x[n]$ is obtained by multiplying discrete-time ramp function $r[n]$ by a rectangular window function and $x[n] = r[n](u[n] - u[n-6])$

(i) Find the energy of $x[n]$.

(ii) Calculate the even $x_e[n]$ and odd $x_o[n]$ components of $x[n]$.

Show that the energy of $x[n]$ is the sum of the energies of $x_e[n]$ and $x_o[n]$. ***(03)***

1B. Seismic signal is sampled at 1 kHz to get discrete-time signal and is processed using symmetric second order FIR filter $h[n]$. The portion of discrete-time seismic signal is given by $x[n] = [\mathbf{1}, 2, 3, 3, 4, 5, 5, 6, 7, 7, 8, 9]$. The impulse response of the FIR filter is $h[n] = [\mathbf{2}, 1, 2]$. Using overlap-add method perform the linear convolution to determine the system response $y[n]$ to the input $x[n]$. Take input sub-blocks of size 4. ***(04)***

1C. Determine the impulse response $h[n]$ of the feedback system shown in Figure Q1C. Comment on stability of the system.

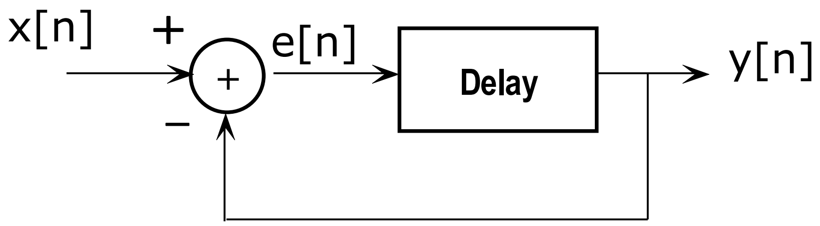

Figure Q1C ***(03)***

2A. Find the constants a, b, and c for a given frequency response $H[\omega]$ of a linear phase FIR system.

Given: $H[0] = \frac{5}{4}$, $H\left[\frac{\pi}{2}\right] = 0$, $H[\pi] = -\frac{1}{4}$, and

$$y[n] = a\,x[n] + b\,x[n-1] + c\,x[n-2] + b\,x[n-3] + a\,x[n-4]$$ ***(03)***

2B. A causal linear phase symmetric FIR system $H(z)$ has 4 zeros and is given by $H(z) = H_1(z)(1 - 0.8z^{-1} + 0.64z^{-2})$. Find $H_1(z)$. Take h[n]=1 for n=0 ***(02)***

2C. For a certain biomedical application, it is required to remove a band of high frequencies and Butterworth filter is used for the same. Design Butterworth filter using Bilinear transformation technique to meet the following specifications:

$$0.8 \leq \left|H\left(e^{j\omega}\right)\right| \leq 1 \; ; \quad 0 \leq \omega \leq 0.4\pi$$

$$\left|H\left(e^{j\omega}\right)\right| \leq 0.2 \; ; \quad 0.6\pi \leq \omega \leq \pi$$

Take T = 1 sec. ***(05)***