PE/PE/H/T/422B/2024

Jadavpur University
B.E.(Power Engg.) 4th Year 2nd Semester 2024
Digital Signal Processing

Full Marks 100 **Answer all Questions** **Time 3 hours**

1. **Assuming** $y[n] = x[n] * h[n]$, $h(n)=\{1,\underset{\uparrow}{-1},2\}$, $x(n)=\{2,1,\underset{\uparrow}{-1},3\}$ **calculate y[n] using the tabular method of discrete convolution.** **CO(1) 10**

   Compute the Energy and Power for the Discrete Signal represented by $x[n] = \left(\frac{1}{4}\right)^n U(n)$ **CO(1) 10**

2. **For a signal** $x(t) = 2\sin(wt) + 3\cos\left(3wt + \frac{\pi}{3}\right) + 0.5\sin(4wt + \frac{\pi}{6})$ **derive the amplitude and phase spectrum. What should be the minimum sampling frequency if** $w = 6.28rad/s$ **CO(2) 20**

   Or

   Assume that $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$ **and a continuous time signal** $x(t)$ **is sampled using** $p(t)$ **to produce** $x_s(t)$ **. Deduce an expression for** $X_s(e^{j\omega})$**, where the symbols have usual significance.** **CO(2) 20**

3. **Develop a MATLAB code to create a single square pulse of width 0.2 secs and unity height. Choose a suitable time vector and sampling frequency and develop the full code to obtain the Power Spectrum of the Signal** **CO(3) 20**

   Or

   Given the FFT of a signal, deduce a MATLAB code for obtaining the Phase Spectrum from FFT . You may also suggest an approximate SIMULINK schematic . **CO(3) 20**

4. **What is the difference between a DFT and a DTFT?**
   For a sequence defined by :

$$X(k) = \begin{Bmatrix} 2, k = 0 \& 0, k = 2 \\ -1 - j, k = 1 \\ -1 + j, k = 3 \end{Bmatrix}$$

   deduce $x[n]$ **as an IDFT of** $X(k)$ **. Symbols have usual significance** **CO(4) 20**

5. **Show that the sequence represented by the figure below represents a simple FIR Hi-pass filter** $H(z)$ **in the Z-plain and deduce its cut-off frequency. Show further that** $H(-z)$ **is an FIR Lo-Pass filter. How will you modify this into an IIR Hi-Pass filter. Deduce the relevant parameters in terms of specified cut-off frequency.** **CO(4) 5+5+5+5**