PES University, Bengaluru

(Established under Karnataka Act 16 of 2013)

END SEMESTER ASSESSMENT (ESA) - JULY - 2023

UE17EC302 - Digital Signal Processing

Total Marks : 100.0

1.a.
The even samples of the 11 point DFT of a length 11 real sequence are given by X(0)=2,X(2)= -1-j3,X(4)=1+j4,X(6)=9+j3,X(8)=5,X(10)=2+j2
Determine the missing odd samples of DFT. (5.0 Marks)

1.b. Let X(k)=(1,j,-1,-j) and H(k)=(0,1,-1,1) be the DFTs of two sequences x(n) and h(n) respectively. Using the properties of DFT, determine the DFT's of the following

1. $X[(n-1)_4]$
2. $DFT\{x(n+3)_4\}$
3. $Y(k)=H(k)X(k)$
4. $DFT\{(-1)^n x(n)\}$
5. $DFT\{j^n x(n)\}$

(10.0 Marks)

1.c. Compute the energy of the N point sequence $x(n) = \cos\left(\frac{2\pi k_0 n}{N}\right) for\ n = 0,1, \dots N-1$

(5.0 Marks)

2.a. Find the DFT of the sequence x(n) = (1,1,1,1,0,0,0,0) using Radix 2 DIT FFT algorithm. (8.0 Marks)

2.b. Derive 8 point FFT-DIF algorithm and draw the Butterfly structure (8.0 Marks)

2.c. Write down the procedural steps to find out linear convolution using overlap-save method. (4.0 Marks)

3.a. Design a Butterworth analog HPF that meets the following requirements:
1.Max pass band ripple is 2dB and passband edge frequency is 200 rad/sec
2.Stopband attenuation is 20dB at 100 rad/sec (6.0 Marks)

3.b. Explain about the Frequency response characteristics of a Butterworth filter in detail. (6.0 Marks)

3.c. Design a Chebyshev analog LPF that has a -3dB cutoff frequency of 100 rad/sec and a stopband Attenuation of 25dB or greater for all radian frequencies past 250 rad/sec (8.0 Marks)

4.a. List out the difference between FIR and IIR filter (5.0 Marks)

4.b. Convert the given H(s) into H(z) using Impulse Invariance transformation. Take T=0.2sec

a) $H(s)=10/s^2+7s+10$
b) $H(s)=s+0.1/(s+0.1)^2+3^2$

(7.0 Marks)

4.c. Design a Lowpass Butterworth digital filter using Bilinear Transformation method for the following specifications
Passband Edge frequency=1KHz
Stopband Edge frequency=3KHz
Passband Ripple=2dB
Stop band attenuation=20dB
Sampling frequency=8KHz (8.0 Marks)

5.a. Realize the following FIR system $H(z)=1-1.3343z^{-1}+0.9025z^{-2}$ in the following forms
a) Direct form b) Lattice form (8.0 Marks)

5.b. Explain about Gibb's phenomenon. How to reduce the effect of Gibbs phenomenon? (6.0 Marks)

5.c. Use the window method with a Hamming window to design a 7 tap Differentiator. The magnitude response of the ideal differentiator is given below.

(6.0 Marks)