Ref. No.: Ex/PG/IEE/T/112A/2024

M.TECH. INSTRUMENTATION AND ELECTRONICS ENGINEERING
FIRST YEAR
FIRST SEMESTER EXAM 2024
SIGNALS AND SYSTEMS

Time: 3Hrs. Full Marks: 100

Answer all questions

1. a) Obtain **DTFT** of the below signals

i) $x(n) = a^n u(n) + a^n u(-n-1)$

ii) $x(n) = A \quad for \quad 0 \le n \le L-1$
$0 \quad otherwise$

b) Calculate the DFT of the sequence $x(n) = \{1,1,0,0\}$

c) Given the two sequences of length 4 are:
$x(n) = \{0,1,2,3\}$
$h(n) = \{2,1,1,2\}$
Find the circular convolution in the graphical method

d) Compute the 8-point circular convolution for the following sequence
$x_1(n) = \{1,1,1,1,0,0,0,0\}$
$x_2(n) = \sin(\frac{3\pi n}{8}) \quad 0 \le n \le 7$

(4+4+4+4+4)=20

2)
a) Why the result of circular and linear convolution is not the same?
b) Discuss Overlap Add method for circular convolution.
c) Describe the Radix-2 Decimation in Time (DIT) algorithm. State the computational complexity using the FFT algorithm

(3+5+12)=20

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3. a) Develop direct form-II realization the transfer function

$$X(Z)=\frac{3+3.6Z^{-1}+0.6Z^{-2}}{1+0.1Z^{-1}-0.2Z^{-2}}$$

b) The transfer function of the discrete-time causal system is given by;

$$X(Z)=\frac{1-Z^{-1}}{1+0.2Z^{-1}-0.15Z^{-2}}$$ draw cascade and parallel realization of the system.

c) Develop the parallel form realization for the digital filter with transfer function

$$X(Z)=\frac{1+2Z^{-1}+Z^{-2}}{1-0.75Z^{-1}+0.125Z^{-2}}$$

d) Discuss bilinear transformation method to design digital filter

4+5+4+7=20

4. a

Find out H(Z) using impulse invariance method at 5 Hz sampling frequency from H(s) as given below

$$H(s) = \frac{2}{(s+1)(s+2)}$$

b) Write the comparison between Impulse invariance and the Bilinear transformation method

c)

The system transfer function of analog filter is given by,

$$H(s) = \frac{s+0.1}{(s+0.1)^2+16}$$

Obtain the system transfer function of digital filter using BLT which is resonant at

$\omega_r = \frac{\pi}{2}$.

d)

Using bilinear transformation, design a butterworth filter which satisfies the following conditions :

$0.8 \le |H(e^{j\omega})| \le 1$ $\quad 0 \le \omega \le 0.2\pi$

$|H(e^{j\omega})| \le 0.2$ $\quad 0.6\pi \le \omega \le \pi$

6+2+6+6=20

5.

a.

A digital low pass IIR filter is to be designed with butter- worth approximation using bilinear transformation technique. Find the order of filter to meet the following specifications.

(i) Passband magnitude is constant within 1 dB for frequencies below 0.2π.

(ii) Stopband attenuation is greater than 15 dB for frequencies between 0.3π to π.

b. Discuss the design of the FIR filter using the window method.

c.

Design a linear phase FIR low pass filter of order seven with cut-off frequency 1 rad/sec using rectangular window.

6+7+7=20