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C033534(033)

B. Tech. (Fifth Semester) Examination, Nov.-Dec. 2021

AICTE (~~New~~ Scheme)

(IT Engg. Branch)

SIGNAL PROCESSING

(BT3033)

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Part (a) of each question is compulsory and it carries 4 marks. Attempt any two part from (b), (c) and (d) of each question.*

Unit-I

1. (a) Define convolution. 4

(b) Find the convolution of two finite duration sequences 8

$$x(n)=\begin{cases}1, & -1\le n\le +1\\ 0, & \text{otherwise}\end{cases}$$

and $$h(n)=\begin{cases}1, & -1\le n\le +1\\ 0, & \text{otherwise}\end{cases}$$

(c) Given two sequences, 8

$$x_1(n)=3\delta(n)+2\delta(n-1)$$

$$x_2(n)=2\delta(n)-\delta(n-1)$$

Find the z-transform of their convolution :

$$X(z)=Z\left(x_1(n)\times x_2(n)\right)$$

(d) Suppose that an analog signal is given as 8

$$x(t)=5\cos(2\times 1000t), \text{ for } t\ge 0$$

and is sampled at the rate of 8,000 Hz.

(i) Sketch the spectrum for the original signal

(ii) Sketch the spectrum of the sampled signal from 0 to 20 kHz.

Unit-II

2. (a) Write properties of FFT? 4

(b) Explain the relation between DTFT and DFT? 8

(c) Given $x(n) = 1, 2, 3, 4, 4, 3, 2, 1$, find $X(k)$ using DIT FFT algorithm. 8

(d) Compute (i) linear and (ii) Circular convolution of the two sequences 8

$$x_1(n)=(1,1,2,2) \text{ and } x_2(n)=(1,2,3,4)$$

Unit-III

3. (a) Difference between Direct Form-I and Direct Form-II method for realizing a digital filter? 4

(b) Determine the parallel realization of IIR digital filter with following transfer function. 8

$$H(z)=\frac{3\left(2z^2+5z+4\right)}{(2z+1)(z+2)}$$

(c) Convert the analog filter into a digital filter whose system function is 8

$$H(s)=\frac{s+0\cdot 2}{(s+0\cdot 2)^2+9}$$

Use the impulse invariant technique. Assume $T=1s$

(d) Design a second-order digital lowpass Butterworth filter with a cutoff frequency of 1·5 kHz and a passband ripple of 3 dB at a sampling frequency of 8,000 Hz. Determine the transfer function and difference equation. 8

Unit-IV

4. (a) Define Hamming window function. 4

(b) Given the following FIR filter : 8

$$y(n)=0\cdot1\,x(n)+0\cdot25x(n-1)+0.2\,x(n-2)$$

Determine the transfer function, filter length, nonzero coefficients and impulse response.

(c) Obtain FIR linear phase and cascade realization of system function. 8

$$H(z)=\left[1+\frac{1}{2}z^{-1}+z^{-2}\right]\left[1+\frac{1}{4}z^{-1}+z^{-2}\right]$$

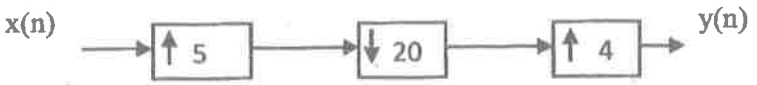
(d) Design a low-pass digital FIR filter using Kaiser windows satisfying the specifications given below. 8

Passband cut-off frequency, *fp*	=	150 Hz
Stopband cut-off frequency, *fs*	=	250 Hz
Passband ripple, *Ap*	=	0.1 dB
Stopband attenuation, *As*	=	40 dB and
Sampling frequency, *F*	=	1000 Hz.

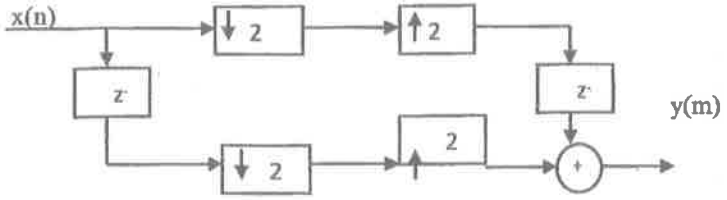
Unit-V

5. (a) What is Decimation and Interpolation? 4

(b) Obtain the expression for the output $y(n)$ in terms of $x(n)$ for the multirate system given as follows: 8



(c) We are given a multi sampling rate system shown in fig. determine $y(n)$ as a function as $y(m)$ 8



(d) Write short notes on speech procesing and image processing. 8