Printed Pages – 6 Roll No. : ....

328651(28)

B. E. (Sixth Semester) Examination April-May 2021

(New Scheme)

(Et & T Engg. Br.)

DIGITAL SIGNAL PROCESSING

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Attempt all questions. Part (a) of each question is compulsory. Attempt any two parts from (b), (c) and (d) of each question.*

Unit - I

1\. (a) Define convolution. 2

(b) Compute circular periodic convolution of the two sequences $x_1(n)=\{1, 1, 2, 2\}$ and $x_2(n)=\{1, 2, 3, 4\}$. 7

(c) Given $x(n)=\{1, 2, 3, 4, 4, 3, 2, 1\}$, find $X(k)$ using DITFFT algorithm. 7

(d) Given : 7

$$X(k)=\{36, -4+j9\cdot 656, -4+j4, -4 + j1\cdot 656, -4, -4-j1\cdot 656, -4j4, -4-j9.656\}$$

find $x(n)$.

Unit-II

2. (a) Define canonic and Non-canonic structures. 2

(b) Determine the direct form I realisation for a third order IIR transfer function. 7

$$H(z)=\frac{0\cdot 28z^2+0\cdot 319z+0\cdot 04}{0\cdot 5z^3+0\cdot 3z^2+0\cdot 17z-0\cdot 2}$$

(c) Obtain a cascade realisation of the system characterised by the transfer function

$$H(z)=\frac{2(z+2)}{z(z-0\cdot 1)(z+0\cdot 5)(z+0\cdot 4)}$$ 7

(d) Determine the parallel realisation of the IIR digital filter transfer functions.

$$H(z)=\frac{3(2z^2+5z+4)}{(2z+1)(z+2)}$$ 7

Unit-III

3. (a) List advantages of FIR filter over IIR filter. 2

(b) A low-pass filter is to designed with the following desired frequency response. 7

$$H_d(e^{jw})=\begin{cases} e^{-j2w}, & -\pi/4 \le w \le \pi/4 \\ 0, & \pi/4 < |w| \le \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$, if the window function is defined as

$$w(n)=\begin{cases} 1 \quad , & 0 \le n \le 4 \\ 0 \quad , & \text{otherwise} \end{cases}$$

determine filter coefficients of the designed filter $h(n)$.

(c) The desired response of a low pass filter is :

$$H_d(e^{jw}) = \begin{cases} e^{-j3w}, & -3\pi/4 \le w \le 3\pi/4 \\ 0, & 3\pi/4 < |w| \le \pi \end{cases}$$

Determine $H(e^{jw})$ for $M = 7$ using a Hamming window. 7

(d) Describe the filter design procedure using Kaiser window function. 7

Unit-IV

4. (a) Define frequency warping. 2

(b) Convert the analog filter into a digital filter whose system function is :

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

Use the impulse invariant technique.

Assume $T = 1$s. 7

(c) Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation.

Assume $T = 1$s

$$0\cdot 9 \le |H(e^{jw})| \le 1 \qquad 0 \le w \le \pi/2$$
$$|H(e^{jw})| \le 0\cdot 2 \qquad 3\pi/4 \le w \le \pi$$

7

(d) Design a digital Chebyshev filter to satisfy the constraints

$$0\cdot 707 \le |H(e^{jw})| \le 1 \quad 0 \le w \le 0\cdot 2\pi$$
$$|H(e^{jw})| \le 0\cdot 1 \quad 0\cdot 5\pi \le w \le \pi$$

Using bilinear transformation and assuming $T = 1$s 7

Unit - V

5. (a) Define upsampler and downsampler. 2

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

$$x(n) \rightarrow \boxed{\uparrow 5} \rightarrow \boxed{\downarrow 20} \rightarrow \boxed{\uparrow 4} \rightarrow y(n)$$

7

(c) Obtain the polyphase decomposition of the IIR system with transfer function :

$$H(z) = \frac{1-4z^{-1}}{1+5z^{-1}}$$ 7

(d) Obtain the two-fold expanded signal $y(n)$ of the input signal $x(n)$.

$$x(n) = \begin{cases} n, & n > 0 \\ 0, & \text{otherwise} \end{cases}$$ 7