328651(28)

B. E. (Sixth Semester) Examination, Nov.-Dec., 2015

(New Scheme)

(ET & T Engg. Branch)

DIGITAL SIGNAL PROCESSING

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

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

1. (a) What are the steps involved in finding out convolution sum? 2

(b) Compute linear and circular periodic convolutions of the two sequences

$x_1(n) = \{1, 1, 2, 2\}$ and $x_2(n) = \{1, 2, 3, 4\}$. 7

(c) Find the inverse DFT of $x(k) = \{1, 2, 3, 4\}$. 7

(d) Given, $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ find $x(k)$ using DIT FFT algorithm. 7

2. (a) Define transpose form of filter design. 2

(b) Obtain Direct Form-I and Direct Form-II realistaion of a system described by

$$y(n) - \frac{3}{4}\, y(n-1) + \frac{1}{8}\, y(n-2) = x(n) + \frac{1}{2}\, x(n-1).$$ 7

(c) Obtain a cascade realization 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) Obtain FIR linear phase and cascade realisation of the system function

$$H(z) = \left(1 + \frac{1}{2}\, z^{-1} + z^{-2}\right)\left(1 + \frac{1}{4} z^{-1} + z^{-2}\right).$$ 7

3. (a) What is a linear phase filter? 2

(b) A low pass filter is to be designed with the following desired frequency response :

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

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

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

Also determine the frequency response $H(e^{jw})$ of the designed filter. 7

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

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

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

(d) Explain the procedure for designing a FIR filter using Kaiser window. 7

4. (a) What is frequency warping? 2

(b) A digital filter with a 3 dB bandwidth of $0{\cdot}2\,\pi$ is to be designed from the analog filter where system response is

$$H(s) = \frac{\Omega_c}{s+\Omega_c}$$

Use bilinear transformation and obtain $H(z)$. 7

(c) Use bilinear transformation to design a Butterworth filter satisfying the constraints 7

$$0{\cdot}8 \le \left| H\left(e^{jw}\right) \right| \le 1 \; ; \; 0 \le w \le 0{\cdot}2\,\pi$$

$$\left| H\left(e^{jw}\right) \right| \le 0{\cdot}2; \quad 0{\cdot}6\,\pi \le w \le \pi.$$

(d) Design a digital Chebyshev filter to meet the following constraints :

$$0{\cdot}8 \le \left| H\left(e^{jw}\right) \right| \le 1 \; ; \; 0 \le w \le 0{\cdot}2\,\pi$$

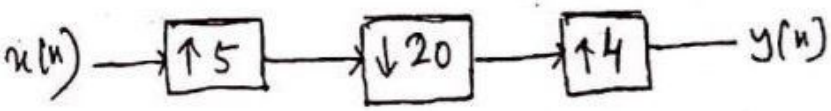
$$\left| H\left(e^{jw}\right) \right| \le 0{\cdot}2; \quad 0{\cdot}6\,\pi \le w \le w$$

using bilinear transformation method. 7

5. (a) Write the applications of Multirate DSP. 2

(b) Explain the process of interpolation with an example. 7

(c) For the multirate system shown in figure, develop an expression for the output $y(n)$ as function of the input $x(n)$. 7



(d) Obtain the polyphase decomposition of the 11 R system with transfer function. 7

$$H(z) = \frac{1+3z^{-1}}{1+4\,z^{-1}}.$$