B.E (Etox) sem 7 (Rev)
Filter Theory & Applications
05/12/07

P-2 ws Oct 07 167

Con. 5029–07. **(REVISED COURSE)** **CD–7092**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.

(2) Solve any **four** questions from remaining **six**.

1. Solve any **five** :– 20

(a) Justify : Ideal filter characteristics are not realizable.

(b) Prove that $H(z) = 1 - 0{\cdot}3z^{-1} + 0{\cdot}3z^{-2} - z^{-4}$ can not be used as LPF.

(c) Convert $H_a(s) = \dfrac{s + 0{\cdot}1}{(s + 0{\cdot}1)^2 + 9}$ into digital filter using impulse invariance method.

(d) Sketch the locations of all zeros of linear phase FIR filter if some of the zeros are at $0{\cdot}5\, e^{J\pi/3}$ and 0·2.

(e) Compare FIR and IIR filters.

(f) Justify : Impulse invariance method can not be used for designing High Pass Filters.

2. A digital Low Pass filter is required to meet following specifications : 20

P. B. ripple	≤	1dB.
P. B. edge	:	4 KHz
S. B. Attenuation	≥	40 dB
S. B. edge	:	6 KHz
Sample rate	:	24 KHz

Using BLT find the order of Butterworth, Chebyshev type – I and Elliptic filter to meet the above specifications.

Also draw the rough sketches of magnitude response of these filters.

3. (a) Design L. P. Filter with following desired response – 14

$$Hd(e^{Jw}) = e^{-J3w} \quad \frac{-3\pi}{4} \le w \le \frac{3\pi}{4}$$

$$= 0 \qquad \frac{3\pi}{4} < |w| < \pi$$

Use Hamming window with M = 7 to obtain H(w).

(b) The frequency response of a filter has a form 6

$H(e^{Jw}) = e^{-J3w}\,[2 + 0{\cdot}8 \cos 3w + 0{\cdot}4 \cos 2w + 0{\cdot}2 \cos w]$

Find the impulse response of the system.

4. A low pass digital filter has following specifications : **20**

$0{\cdot}8 \leq |H(e^{Jw})| \leq 1$ for $0 \leq w \leq 0{\cdot}2\pi$

$|H(e^{Jw})| \leq 0{\cdot}2$ for $0{\cdot}6\ \pi \leq w \leq \pi$

Using Butterworth approximation :

(a) Find the order of the filter

(b) Find analog cutoff frequency

(c) Plot the poles of H(s)

(d) Obtain H(z) for low pass digital filter

(e) Find H(z) for high pass digital filter using above result.

5. (a) Desired frequency response of digital filter is – **12**

$$Hd(e^{Jw}) = e^{-J3w} \quad 0 \leq w \leq \pi/2$$
$$= 0 \quad \pi/2 \leq w \leq 3\pi/2$$
$$= e^{-J3w} \quad 3\pi/2 \leq w \leq 2\pi$$

Determine the filter coefficients h(n) for M = 7 using frequency sampling technique.

(b) Determine the unit sample response h(n) for linear phase FIR filter with M = 4 for which frequency response at w = 0 and w = $\pi/2$ is $H_r(o) = 1$; $H_r(\pi/2) = 1/2$. **8**

6. (a) Discuss design procedure of Bessel filters. **10**

(b) Find cascade and parallel realization of IIR digital transfer function – **10**

$H(z) = 3(2z^2 + 5z + 4) / (2z + 1)(z + 2)$

7. Write short notes on any **three** :– **20**

(a) Bilinear transformation

(b) Matched – z transform

(c) Design steps of FIR filter using Kaiser Window

(d) Characteristics of different Windows.