7. Design a digital Butterworth filter that satisfies the following constraint using billinear transformation. Assume T = 1 sec. **15**

$0.9 \leq |H(e^{jw})| \leq 1 \qquad 0 \leq w \leq \pi/2$

$|H(e^{jw})| \leq 0.2 \qquad 3\pi/4 \leq w \leq \pi$

Roll No. ..... Total Pages : 04

017605

May 2024

B.Tech. (EEIOT) (Sixth Semester)

Signal Processing Techniques (EEN-601)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) Check the following system is BIBO stable or not :

$y(n) = ax(n) + b.$ **1.5**

(b) Compute the energy of a discrete signal :

$x(n) = (1/4)\ ^n)\ u(n).$ **1.5**

(c) Find z-transform of $x(n) = 6^n\ u(n - 3)$. **1.5**

(d) What is the condition for FIR system to have linear phase ? **1.5**

(e) What is Gibb's phenomenon ? **1.5**

(f) What is the convolution of a signal with an impulse ? **1.5**

(g) What is the ROC of the signal $x(n) = \delta(n-k), k > 0$? **1.5**

(h) What is Decimation ? **1.5**

(i) What are the advantages of cascade realization ? **1.5**

(j) In The Bilinear Transformation, the Relationship between ω and Ω is. **1.5**

Part B

2. (a) Develop cascade and parallel realization structures for :

$H(z) = (1 + 0.25\ z^{-1})/(1 + 0.5\ z^{-1})(1 + 0.5z^{-1} + 0.25z^{-2})$ **10**

(b) Compare IIR and FIR filters. **5**

3. (a) Check whether the following system is linear and time invariant :

$y(n) = a[x(n)]^2 + bx(n)$ **7**

(b) Determine the inverse Z transform of the following $X(z)$ by the partial fraction expansion method : $X(z) = (z + 2)/(2z^2 - 7z + 3)$ if the ROCs are :

(a) $|z| > 3$, (b) $|z| < 0.5$ and (c) $0.5 < |z| < 3$. **8**

4. A filter is to be designed with the following desired frequency response : **15**

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

Determine the filter coefficents $h\ d\ (n)$ if the window function is defined as :

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

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

5. (a) What is the need for multi rate signal processing ? **5**

(b) Given $x(n) = 2^n$ and $N = 8$, find $X(k)$ using DIT FFT Algorithm. **10**

6. (a) Explain AR, MA, ARMA models for power spectrum estimation. **10**

(b) Compute the circular convolution of the sequences $x_1(n) = \{1, 1, 2, 2\}$ and $x_2(n) = \{1, 2, 3, 4\}$. **5**