Digital Systems and Designs

Tutorial 2

Question 01

Convert the following analog filter with transfer function

$$H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$$

into a digital IIR filter by using bilinear transformation. The digital IIR filter is having a resonant frequency of $\omega_r = \pi/2$.

Question 02

Apply the bilinear transformation to

$$H_a(s) = \frac{4}{(s+3)(s+4)}$$ with $T = 0.5$ s and find $H(z)$.

Question 03

Using the bilinear transformation, obtain $H(z)$ from $H_a(s)$ when $T = 1$s and $H_a(s) = \dfrac{s^3}{(s+1)(s^2+2s+2)}$

Question 04

Design a Butterworth digital filter using the bilinear transformation. The specifications of the desired low-pass filter are:

$$0.9 \le |H(\omega)| \le 1; \quad 0 \le \omega \le \frac{\pi}{2}$$

$$|H(\omega)| \le 0.2; \quad \frac{3\pi}{4} \le \omega \le \pi \qquad \text{with } T = 1 \text{ s}$$

Question 05

Design a low-pass Butterworth digital filter to give response of 3 dB or less for frequencies upto 2 kHz and an attenuation of 20 dB or more beyond 4 kHz. Use the bilinear transformation technique and obtain $H(z)$ of the desired filter.

2021

0 - 2

3 dB

4 —

20 dB

Digital Systems and Designs

Tutorial 2

Question 06

Design a low-pass Butterworth filter using the bilinear transformation method for satisfying the following constraints:

Passband: 0–400 Hz

Passband ripple: 2 dB

Sampling frequency: 10 kHz

Stopband: 2.1– 4 kHz

Stopband attenuation: 20 dB