GANDAKI COLLEGE OF ENGINEERING AND SCIENCE
Affiliated to Pokhara University

Level: Bachelor | Year: 2024

Programme: BE "Computer" | Full Marks: 100

Course: Digital Signal Analysis and Processing | Pass Mark: 45

Semester: VIII | Time: 3 Hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Define Signal Analysis and Signal Processing. What are the advantages of Digital signal processing over Analog signal processing? (4+3=7)

   b) State and prove the necessary and sufficient conditions for an LTI system to be causal and stable. (4+4=8)

2. a) Find the convolution between two signals $x(n) = a^n$, for $0 \leq n \leq 6$ and $h(n) = 1$, for $0 \leq n \leq 4$. (8)

   b) Define Z-transform. Find the inverse z-transform of

   $$X(z) = \log(1 + az^{-1}), \ |z| > |a|$$ (1+6=7)

3. a) Why do we need DFT when we have DTFT? Determine the circular convolution of the sequence $x_1(n) = (\mathbf{1}, 2, 3, 4)$ and $x_2(n) = (\mathbf{5}, 6, 7, 8)$ (2+5=7)

   b) Using DIT-FFT compute DFT of $x(n) = \cos\left(\frac{n\pi}{4}\right), \ 0 \leq n \leq 7$ (8)

4. a) Obtain the parallel form realization of following IIR filter

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

   b) Convert the following IIR filter into lattice ladder structure

   $$H(z) = \frac{1+z^{-1}+2z^{-2}+z^{-3}}{1+\frac{13}{24}z^{-1}+\frac{5}{8}z^{-2}+\frac{1}{3}z^{-3}}$$ (8)

5. a) Design a linear FIR filter using Kaiser window to meet the following specifications:

$$0.99 \leq \left|H(e^{i\omega})\right| \leq 1.01; for\ 0 \leq |\omega| \leq 0.19\pi$$

$$\left|H(e^{i\omega}\right| \leq 0.01; for\ 0.21\pi \leq |\omega| \leq \pi \quad (8)$$

b) How can you design FIR filter using rectangular window? Explain. (7)

6. a) Obtain H(z) using the impulse invariant technique for an analog system function which is given by:

$$H_a(S) = \frac{1}{(S+0.5)(S^2+0.5S+2)} \quad (7)$$

b) Design a digital Butterworth filter that satisfies the following constraints using bilinear transformation. Assume T=1s.

$$0.8 \leq \left|H\left(e^{j\omega}\right)\right| \leq 1;\ \ 0 \leq \omega \leq 0.2\pi$$

$$\left|H(e^{j\omega})\right| \leq 0.2;\quad 0.6\pi \leq \omega \leq \pi \quad (8)$$

7. Write short notes on (any two): (2×5 =10)

a) ROC and its Properties

b) Gibbs Phenomena

c) Elements of Digital Signal Processing