CBCS SCHEME

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21EE63

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Signals and Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note : ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

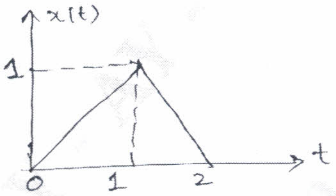
Module-1

1 a. Define Signal. Discuss the classification of signals and also draw the waveforms and necessary equations. **(08 Marks)**

b. Determine whether the given signal is energy or power signal. Also find the values of 'E' and 'P'. i) $x(t) = e^{-3t} \cdot u(t)$ ii) $x(t) = \cos t$. **(08 Marks)**

c. Sketch the odd and even component of the given signal x(t), shown in fig. Q1(c) below. **(04 Marks)**

Fig. Q1(c)



OR

2 a. Determine whether the following signals are periodic or non – periodic signals and also find the fundamental period.
i) $x(t) = \cos 2t + \sin 3t$ ii) $x(n) = \cos(0.01\pi n)$ iii) $x(n) = \sin 3n$. **(06 Marks)**

b. Define System. Discuss any four properties of system. **(08 Marks)**

c. For the following system, determine whether the system is :
i) Linear ii) Time – Invariant iii) Memory less iv) Causal v) stable.
Given $y(t) = e^{x(t)}$. **(06 Marks)**

Module-2

3 a. Calculate the 8 – point DFT of the sequence x(n) = {1, 1, 1,1, 0, 0, 0, 0}. Also plot the magnitude and phase plot. **(10 Marks)**

b. The sequence x(n) = {3, 0, -2, 0, 2, 1, 0, -2, -1, 0} is filtered through a filter whose impulse response is h(n) = {1, 1, 1}. Compute the output of the filter y(n) using Overlap – Add method. Use 5 – point circular convolution. **(10 Marks)**

OR

4 a. State and prove the following properties of DFT.
i) Periodicity property ii) Linearity property. **(08 Marks)**

b. Determine the circular convolution of the sequences using DFT – IDFT method.
$x_1(n) = \{2, 1, 2, 1\}$ & $x_2(n) = \{1, 2, 3, 4\}$. **(08 Marks)**

c. Determine the IDFT of the following sequence :
$x(k) = \{1, 1 - j\,1.414, 1, 1 + j\,1.414\}$. **(04 Marks)**

Module-3

5 a. Define FFT. Discuss the number of multiplications and additions required for N = 8 and N = 16. Also find the speed improvement factor. **(06 Marks)**

b. Discuss the similarities and differences between DIT – FFT and DIF – FFT algorithm. (04 Marks)

c. Develop the 8 – point DIT – FFT Radix – 2 algorithm and also draw the signal flow graph. (10 Marks)

OR

6 a. Determine the DFT of the given sequence
$x(n) = \{2, 1, 4, 6, 5, 8, 3, 9\}$ using DIF – FFT algorithm. (10 Marks)

b. Find the DFT of the sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using DIT – FFT algorithm. (10 Marks)

Module-4

7 a. Discuss the difference between IIR and FIR filter. (04 Marks)

b. Design an analog Butterworth filter with maximally flat response in the pass band and an acceptable attenuation of -2 dB at 10 rad/sec. The attenuation in the stop band should be more than -10dB beyond 20 rad/sec. (10 Marks)

c. Transform the analog filter $H(s) = \dfrac{s+0.1}{(s+0.1)^2+9}$ into a digital filter using Impulse Invariant transformation. (06 Marks)

OR

8 a. Explain the bilinear transformation method of converting analog filter into digital filter. Show the mapping from S - plane to Z - plane, also obtain the relation between 'w' and 'Ω'. (08 Marks)

b. Develop the Direct form – I, Direct form – II, Cascade and Parallel form realization structures for the following difference equation.
$y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$. (12 Marks)

Module-5

9 a. Define window function. Explain the different types of window functions with necessary equations. Also draw the time domain and magnitude response plot for each type. (10 Marks)

b. Design the symmetric FIR filter whose desired frequency response is given by

$$H_d(w) = \begin{cases} e^{-jw\tau} & \text{for } |w| \le w_c \\ 0 & \text{otherwise} \end{cases}$$. Use Rectangular window.

The length of the filter should be 7 and $w_c = 1$ rad/sample. Use Rectangular window. (10 Marks)

OR

10 a. Design the symmetric FIR low pass filter whose desired frequency is given as

$$H_d(e^{jw}) = \begin{cases} e^{-j3w} & \frac{-3\pi}{4} \le w \le 3\pi/4 \\ 0 & \frac{3\pi}{4} < |w| \le \pi \end{cases}$$. Determine $H(e^{jw})$ for m = 7. Use Hamming window. (10 Marks)

b. Realize the following system transfer function in Direct form realization
$H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$. (04 Marks)

c. Realize the following system transfer function in linear – phase realization techniques.
$H(z) = \frac{1}{2} + \frac{1}{7}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + \frac{1}{4}z^{-4} + \frac{1}{2}z^{-5}$. (06 Marks)

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