CBCS SCHEME

USN [| | | | | | | | |] **21EE63**

Sixth Semester B.E. Degree Examination, June/July 2024
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. Distinguish between
   i) Continuous and Discrete time signal
   ii) Even and odd signal
   iii) Periodic and Non-periodic signal
   iv) Energy and power signal **(08 Marks)**

b. Let y(t) and x(t) are given in Fig Q1(b). Sketch the following signal $z(t) = x(2t)*y(1/2t + 1)$

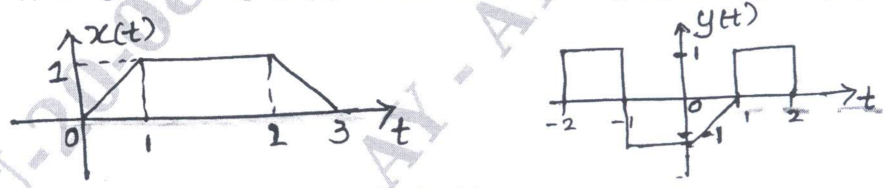

Fig Q1(b) **(06 Marks)**

c. Check whether the following signals are periodic or not. If periodic, find the fundamental period.
   i) $x_1(n) = \cos 2\pi n$
   ii) $x_2(t) = \cos 2\pi t . \sin 4\pi t$. **(06 Marks)**

OR

2 a. Determine whether the following signals are linear, time – invariant memory causal, stable.
   i) $y(n) = x(n^2)$
   ii) $y(t) = \dfrac{d}{dt}[e^{-t}x(t)]$. **(08 Marks)**

b. Evaluate the continuous time convolution integral given below :
   $y(t) = e^{-2t}u(t) * u(t + 2)$ **(06 Marks)**

c. Compute the convolution of the sequences.
   $x(n) = \alpha^n u(n)$; $y(n) = \beta^n u(n)$
   When $\alpha \# \beta$; and $\alpha = \beta$. **(06 Marks)**

Module-2

3 a. Compute 4 point DFT of causal three samples sequence given by
   $x(n) = \dfrac{1}{3}$; $0 \le n \le 2$
   $= 0$; else **(06 Marks)**

b. Compute 6-point DFT of the sequence x(n) = [4, 3, 2, 1, 0, 0]. Also plot magnitude and phase spectrum. **(08 Marks)**

c. Prove the following properties of DFT
   i) Linearity
   ii) Circular time shift. **(06 Marks)**

OR

4 a. Consider a FIR filter with impulse response h(n) = [3, 2, 1, 1] if the input is x(n) = [1, 2, 3, 3, 2, 1, −1, −2, −3, 5, 6, −1, 2, 0, 2, 1]. Find the output y(n). Use overlap-add method, assuming the length of block is 7. **(10 Marks)**

b. Find the IDFT of the given sequence x(k) = [3, 2 + j, 1, 2 − j]. **(05 Marks)**

c. Perform circular convolution of $x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$ using circular shift method. **(05 Marks)**

Module-3

5 a. Develop decimation in time algorithm for finding FFT. Draw signal flow graph for N = 8 for DT algorithm. **(10 Marks)**

b. Find the 8-point DFT of the following sequence using radix – 2 DIF – FFT algorithm. x(n) = [2 1 2 1]. **(10 Marks)**

OR

6 a. Tabulate the number of complex multiplications and complex additions required for the direct computation of DFT and FFT algorithm for N = 8, 16, 32. **(08 Marks)**

b. Find the 8 – point DFT of the sequence x(n) = [1, 1, 1, 1, 0, 0, 0, 0] using DIT – FFT radix – 2 algorithm. Draw the signal flow graph. **(12 Marks)**

Module-4

7 a. Let $H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$ represent the transfer function of a low-pass filter with a passband of 1 rad/sec. Use frequency transformation to find the transfer function of the following analog filters.

i) A low pass filter with passband of 10rad/sec
ii) A high pass filter with cut-off frequency of 10 rad/sec. **(06 Marks)**

b. Compare Butterworth and Chebyshev filter approximations. **(04 Marks)**

c. Design a butterworth analog high pass filter that will meet the following specifications :

i) Maximum passband attenuation = 2dB
ii) Passband edge frequency = 200 rad/sec
iii) Minimum stopband attenuation = 20dB
iv) Stopband edge frequency = 100 rad/sec. **(10 Marks)**

OR

8 a. Transform $H(s) = \frac{s+a}{(s+a)^2 + b^2}$ into digital filter using impulse invariant technique. **(08 Marks)**

b. Design the digital filter using Chebyshev approximation and bilinear transformation to meet the following specifications. Passband ripple = 1dB, for $0 \le w \le 0.15\pi$ stopband attenuation ≥ 20dB for $0.45\pi \le w \le \pi$. **(12 Marks)**

Module-5

9 a. The desired frequency response of the lowpass filter is given by

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j3w} \ ; & |w| < 3\pi/4 \\ 0 \ ; & 3\pi/4 < |w| < \pi \end{cases}$$

Determine the frequency response of FIR filter if the hamming window is used, with N = 7. **(10 Marks)**

b. Design an ideal band pass filter with frequency response
$H_d(e^{jw}) = 1$, for $\pi/4 \le |w| \le 3\pi/4$. Use rectangular window with N = 11 in the design. **(10 Marks)**

OR

10 a. Obtain the direct form – I and direct form – II, cascade and parallel realizations for the following system.
$y(n) = 0.75\,y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$ **(10 Marks)**

b. Given the FIR filter with following difference equation
$y(n) = x(n) + \frac{3}{4}x(n-1) + \frac{17}{8}x(n-2) + \frac{3}{4}x(n-3) + x(n-4)$. Draw direct form – I and cascade form. **(06 Marks)**

c. Realize the linear phase filter with the impulse response.
$h(n) = \delta(n) - \frac{1}{2}(n-1) - \frac{1}{4}\delta - \frac{1}{4}\delta(n-2) + \frac{1}{4}\delta(n-3) - \frac{1}{2}\delta(n-4) + \delta(n-5)$. **(04 Marks)**

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