

CBCS SCHEME

21EE63

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026 Signals and Digital Signal Processing

Time: 3 hrs.

Max. Marks: 100

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

Module-1

1 a. Compare the following classification of signals :

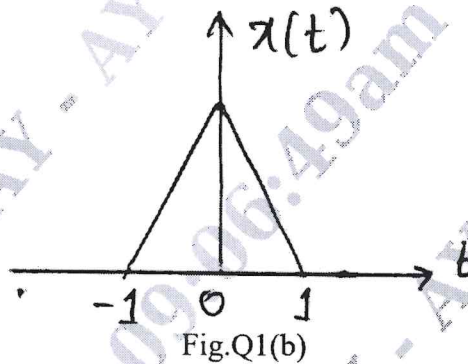
- i) Continuous-time and Discrete-time signals
- ii) Even and Odd signals.

(06 Marks)

b. Sketch the following signals for $x(t)$ as shown in Fig.Q1(b). Find :

- i) $x(3t + 2)$ ii) $x(4t - 2)$ iii) $x(2t - 4)$ iv) $x(-2t - 1)$.

(08 Marks)



c. Determine whether the given system is

- i) Linear
- ii) Time invariant
- iii) Memory less
- iv) Causal
- v) Stable for

$$T\{x(t)\} = e^{x(t)}$$

(06 Marks)

OR

2 a. Consider a continuous-time LTI system with unit impulse response.

$$h(t) = u(t) \text{ and } x(t) = e^{-at} u(t) \text{ for } a > 0$$

Find the output of the system using convolution method.

(10 Marks)

b. Consider an input $x(n)$ and unit impulse response $h(n)$ given by

$$x(n) = \alpha^n u(n), 0 < \alpha < 1 \text{ and } h(n) = u(n).$$

Evaluate using convolution.

(10 Marks)

Module-2

3 a. Prove the following DFT properties :

i) Linearity

ii) Circular –time shift.

(06 Marks)

b. Find the 5-point DFT of the sequence $x(n) = \{1, 1, 1, 0, 0\}$. Sketch the magnitude and phase spectrum.

(08 Marks)

c. Determine whether the following signals are periodic or not. If periodic find the fundamental period.

i) $x(t) = \cos 100 \pi t + \sin 50 \pi t$

ii) $x(n) = \cos\left(\frac{n}{8}\right) \cos\left(\frac{n\pi}{8}\right)$.

(06 Marks)

OR

4 a. Compute circular convolution using DFT and IDFT for the following sequence :

$$x_1(n) = \{2, 3, 1, 1\} \text{ and } x_2(n) = \{1, 3, 5, 3\}.$$

(08 Marks)

b. A long sequence $x(n)$ is filtered through a filter with impulse response $h(n)$ to yield the output $y(n)$. If $x(n) = \{1, 4, 3, 0, 7, 4, -7, -7, -1, 3, 4, 3\}$ and $h(n) = \{1, 2\}$

Compute $y(n)$ using overlap add technique. Use only 5-point circular convolution in your approach.

(12 Marks)

Module-3

5 a. Obtain the 8-point DFT of the following sequence using Radix-2 DIT-FFT algorithm for the sequence :

$$x(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}.$$

(10 Marks)

b. If $x_1(n) = \{1, 2, 0, 1\}$ and $x_2(n) = \{1, 3, 3, 1\}$. Obtain $x_1(n) \otimes x_2(n)$ by using DIT-FFT algorithm.

(10 Marks)

OR

- 6 a. First 5-points of the 8-point DFT of a real valued sequence is given by $X(0) = 0$, $X(1) = 2 + j2$, $X(2) = -j4$, $X(3) = 2 - j2$, $X(4) = 0$. Determine the remaining points. Hence find the original sequence $x(n)$ using inverse DIF – FFT algorithm. (14 Marks)
- b. Calculate the number of complex multiplications and complex additions required for the direct computations of DFT and FFT algorithm for $N = 8, 16$ and 32 . (06 Marks)

Module-4

- 7 a. Design an analog bandpass filter to meet the following frequency domain specifications :
- i) A -3.0103 dB upper and lower cut-off frequency of 50 Hz and 20 KHz
 - ii) A stopband attenuation of at least 20 dB at 20 Hz and 45 KHz
 - iii) A monotonic frequency response. (10 Marks)
- b. Design a Chebyshev filter to meet the following specifications :
- i) Passband ripple : ≤ 2 dB
 - ii) Passband edge : 1 rad/sec
 - iii) Stopband attenuation : ≥ 20 dB
 - iv) Stopband edge : 1.3 rad/sec. (10 Marks)

OR

- 8 a. Determine the system function $H(z)$ of the lowest order Chebyshev filter that meets the following specifications :
- i) 3 dB ripple in the passband $0 \leq |\omega| \leq 0.3\pi$
 - ii) At least 20 dB attenuation in the stopband $0.6\pi \leq |\omega| \leq \pi$
- Use bilinear transformation. (12 Marks)
- b. Transform the analog filter $H_a(s) = \frac{s+1}{s^2+5s+6}$ into $H(z)$ using impulse invariant transformation. Take $T = 0.1$ sec. (08 Marks)

Module-5

- 9 a. A lowpass filter is to be designed with the following desired frequency response

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2\omega}, & |\omega| < \pi/4 \\ 0, & \pi/4 < |\omega| < \pi \end{cases}$$

Determine the filter co-efficient $h_d(n)$ and $h(n)$, if $\omega(n)$ is a rectangular window defined as

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

Also find the frequency response.

(10 Marks)

- b. Determine the impulse response $h(n)$ of a filter having desired frequency response

$$H_d(e^{j\omega}) = \begin{cases} e^{-j(N-1)\omega/2}, & \text{for } 0 \leq |\omega| \leq \pi/2 \\ 0, & \text{for } \pi/2 \leq |\omega| \leq \pi \end{cases}$$

$N = 7$. Use frequency sampling approach.

(10 Marks)

OR

- 10 a. Obtain Direct form –II, cascade form and parallel form realization for the following system

$$y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2).$$

(14 Marks)

- b. Obtain linear phase realization of :

$$h(n) = \delta(n) + \frac{1}{2}\delta(n-1) - \frac{1}{4}\delta(n-2) + \frac{1}{2}\delta(n-3) + \delta(n-4).$$

(06 Marks)
