

Duration – 3 Hours

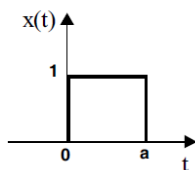
Total Marks- 80

- N.B.:** - (1) Question No.1 is compulsory.
 (2) **Attempt** any **Three** questions out of the remaining **five** questions.
 (3) Assume suitable data if necessary and justify the same.

Q 1. Answer **all** questions.

A) Sketch even and odd parts of the signal

05



B) Determine the inverse Z transform of the following

05

$$X(z) = \frac{z - 0.4}{z^2 + z + 2}$$

C) Determine the Fourier series representation of the following discrete time signals $x(n) = 2\cos\sqrt{3}\pi n$

05

D) Write a note on bilinear transformation used in filter design

05

Q 2 a) State whether the following system is linear, causal, time-invariant and stable
 $y(n) = nx(n) + x(n+2) + y(n-2)$

10

Q 2 b) (i) Determine the transfer function $H(z)$ of the following system

10

$$y(n) - 0.5y(n-1) = x(n)$$

(ii) Determine whether the given signals are periodic or not, if periodic find the fundamental period.

A) $\sin(1.2\pi t)$

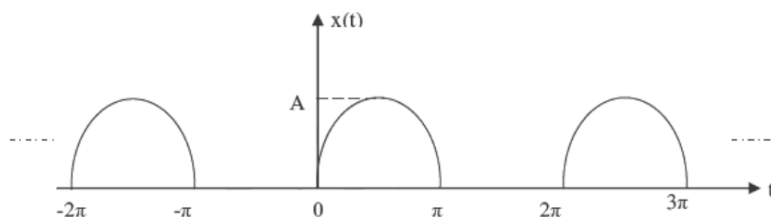
B) $x(t) = 3\cos(4t) + 2\sin(\pi t)$

Q 3 a) The length of an FIR filter is 9. If the filter has a linear phase-show that the following equation is satisfied, $\sum_0^{M-1} h(n)[\sin(\omega\tau - \omega n)] = 0$

10

Q 3 b) Calculate the trigonometric fourier series expansion of the waveform

10



Q 4 a) An LTI system is described by the difference equation 10

$$y(n) - \frac{9}{4}y(n-1) + \frac{1}{2}y(n-2) = x(n) - 3x(n-1)$$

Specify the ROC of $H(z)$, and determine the $h(n)$ for the following conditions

a) the system is stable

b) the system is causal

Q 4 b) Find the convolution of the sequences 10

$$x_1(n) = \left(\frac{1}{3}\right)^n u(n) \text{ and } x_2(n) = \left(\frac{1}{5}\right)^n u(n)$$

Using the convolution property of Z transforms

Q 5 a) i. Perform IDFT using the matrix method to obtain $x(n)$ of the following 10
signal $X(k) = \{1, 0, 1, 0\}$

ii. In an LTI system i/p $x(n) = \{1, 1, 1\}$ and the impulse response $h(n) = \{-1, -1\}$. Determine $Y(k)$ of the system by radix-2 DIT FFT

Q 5 b) An 8-point sequence is given by $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$. Derive 8-point DFT of $x(n)$ by radix-2 DIT-FFT 10

Q 6 a) The desired response of a low-pass filter is 10

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}, & -\frac{3\pi}{4} \leq \omega \leq \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < \omega \leq \pi \end{cases}$$

Determine $H(e^{j\omega})$ for $M=7$ using a Hamming window.

Q 6 b) Design a digital Butterworth low pass filter satisfying the following equation 10

$$0.7 \leq |H(e^{j\omega})| \leq 1 \quad 0 \leq \omega \leq 0.2\pi$$

$$|H(e^{j\omega})| \leq 0.3 \quad 0.6\pi \leq \omega \leq \pi$$
