

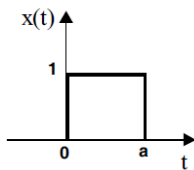
Duration – 3 Hours

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 **10**  
 $y(n) = nx(n) + x(n+2) + y(n-2)$

Q 2 b) (i) Determine the transfer function  $H(z)$  of the following system **10**

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

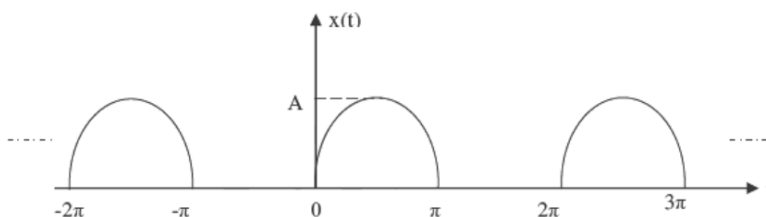
(ii) Determine whether the given signals are periodic or not, if periodic find the fundamental period.

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 signal X(k) = {1,0,1,0} 10

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,}. 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

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

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

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