1T00836 - T.E.(Electrical Engineering)(SEM-VI)(Choice Base Credit Grading System) (R- 19) ('C' Scheme) / 89304 - Signals and Systems QP CODE: 10038283 DATE: 18/12/2023

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 the signal, x(t) = 2 u(t) + t u(t) – [(t - 1) u(t - 1)] -3 u(t - 2) **05**

B) Determine the inverse Z transform of the following **05**

$$X(z) = \frac{1 + z^{-1}}{1 - z^{-1} + 0.5z^{-2}}$$

C) Define mixed phase, minimum phase and maximum phase system. **05**

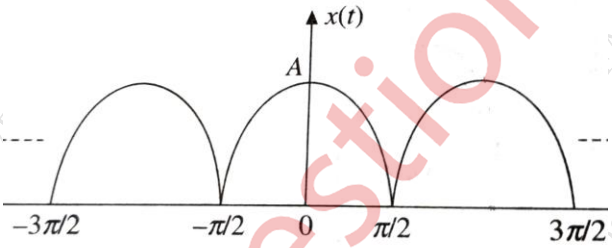
D) Perform bilinear transformation to $H(s) = \frac{2}{(s+1)(s+3)}$ with T=0.1s **05**

Q 2 a) i) Test the causality of y(t) = x(t) + 3 x(t + 4) **10**
ii) Test the linearity of $y(t) = e^{x(t)}$.
iii) Test the stability of the LTI system, whose impulse response is $h(t) = e^{-4t} u(t)$
iv) State whether the systems is time invariant or not y(t) = x(t) sin20Πt

Q 2 b) Determine the step response of an LTI system whose impulse response h(n) is given by $h(n) = a^{-n} u(-n)$; 0 < a < 1. **10**

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) (i) An LTI system is governed by the equation, **10**
y(n) = -2 y(n- 2) - 0.5 y(n- 1) + 3 x(n- 1) + 5 x(n). Determine the transfer function of the system.
ii) Find the Z-transform of $x(n) = a^{n+1} u(n+1)$.

Q 4 b) Using Z-transform, perform deconvolution of the response **10**
y(n) = (1, 4, 8, 8, 3, -2, -1) and impulse response h(n) = (1, 2, 1, -1) to extract the input x(n).

Q 5 a) Determine the X(k) of the LTI system when the input sequence **10**
x(n) = {-1, 1, 2, 1, -1} by radix 2 DIT FFT.

Q 5 b) $Y(k) = \left\{0,\ -\sqrt{2}+j(2+\sqrt{2}),\ 0,\ \sqrt{2}-j(2-\sqrt{2}),\ 8,\ \sqrt{2}+j(2-\sqrt{2}),\ 0,\ -\sqrt{2}-j(2+\sqrt{2})\right\}$ **10**
Find the 8 point inverse DFT of using radix-2 DIT FFT

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

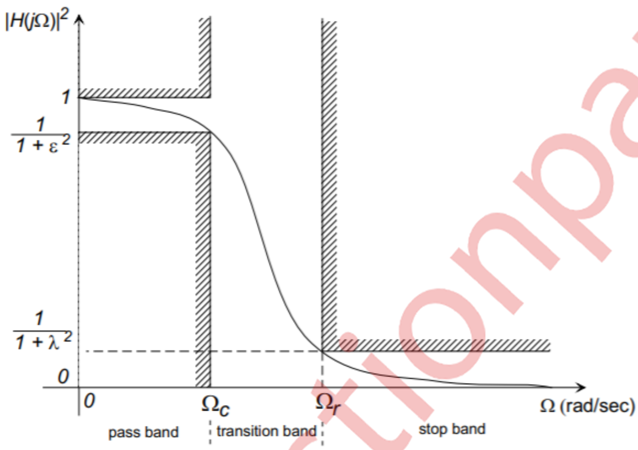
$$H_d(e^{jw}) = \begin{cases} e^{-j3\omega}, & \frac{-3\pi}{4} \le |w| \le \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |w| \le \pi \end{cases}$$

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

Q 6 b) Butterworth filter has a magnitude response given by **10**

$$|H(j\Omega)| = \frac{A}{\left[1+(\Omega/\Omega_c)^{2N}\right]^{0.5}}$$

Where A is the filter gain and Ωc is the 3dB cut off frequency and N is the order of the filter. The design parameters of the buttworth filter are obtained by considering the LPF with the desired specifications as shown in fig



Derive the equation to find the order 'N' of filter in terms of filter specification

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