$n \geq 2$ and $n < 0$.

ii. $H\left(\frac{\pi}{2}\right) = 1$.

iii. $H(\omega) = H(\omega - \pi)$. (9 × 2 = 18)

[This question paper contains 8 printed pages.]

Your Roll No..............

Sr. No. of Question Paper : 8607 J

Unique Paper Code : 2942822401

Name of the Paper : Signals and Systems

Name of the Course : B. Tech (ECE)

Semester : IV

Duration : 3 Hours Maximum Marks :90

Instructions for Candidates

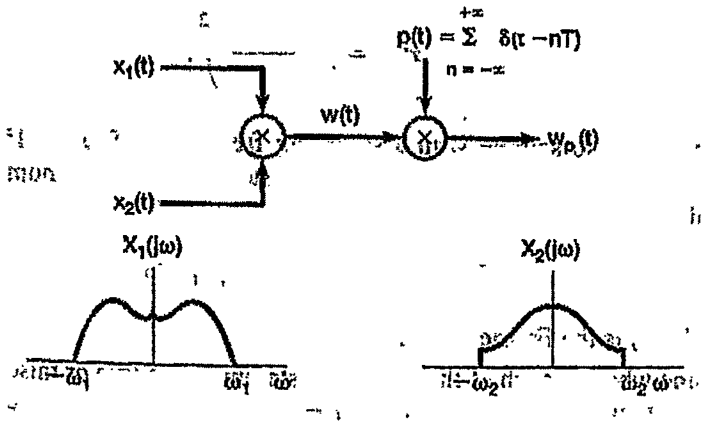
1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt **five** questions in all, including **question no. 1**, which **is compulsory**.

3. All questions carry equal marks.

1 (a) In the system shown below, two functions of time $x_1(t)$ and $x_2(t)$ are multiplied together, and the product $w(t)$ is sampled by a periodic impulse train. $x_1(t)$ is band limited to ω_1, and $x_2(t)$ is band

limited to ω_2



Determine the maximum sampling interval T such that w(t) is recoverable from $w_p(t)$ through the use of an ideal low pass filter.

(b) Consider a periodic signal x(t) with period T=2,

$$x(t) = \begin{cases} 1, & 0 \le t \le 1 \\ -2, & 1 < t < 2 \end{cases}$$

An impulse train g(t) with same period is given. If following is give

(b) Following signal is given:

$$g(t) = x(t)cos^2 t * \frac{sin(t)}{\pi t}$$

Given that x(t) is real and $X(\omega) = 0$ for $|\omega| \geq 1$, show that there exists an LTI system 's' such that, $x(t) \xrightarrow{S} g(t)$ (9 × 2 = 18)

6. (a) The Fourier Transform of a signal x[n] is as follows -

$$X(\omega) = \frac{1}{1 - e^{-j\omega}} \left(\frac{sin\left(\frac{3}{2}\omega\right)}{sin\left(\frac{\omega}{2}\right)} \right) + 5\pi\delta(\omega), \qquad -\pi < \omega \le \pi$$

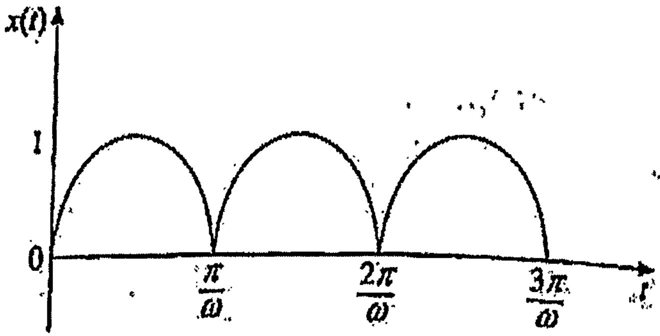
Find x(n)

(b) Following information is given about an LTI system 'S' with impulse response h[n] and frequency response H(ω):

i. $\left(\frac{1}{4}\right)^n u[n] \to g[n]$, where $g[n] = 0$ for

(b) Find the Laplace Transform of the following:

i. Full – Wave Rectifier output shown below –



ii. $x(t) = \sin(\pi t)\,u(t)$ (9 × 2 = 18)

5. (a) Find and plot the impulse response of a system with the frequency response given as follows –

$$H(\omega) = \frac{\left(\sin^2(3\omega)\right)\cos(\omega)}{\omega^2}$$

Note: Mention the values that the impulse response assumes for a particular range.

n, $$\frac{dx(t)}{dt} = A_1 g(t - t_1) + A_2 g(t - t_1)$$

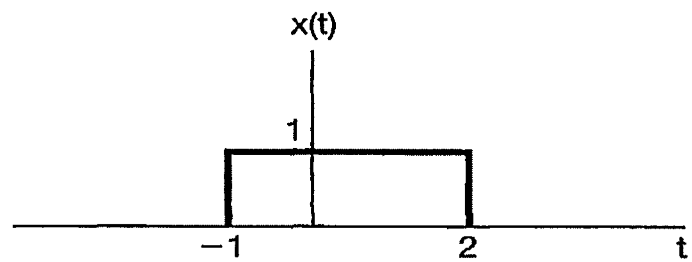
Determine the values A_1, t_1, A_2, and t_2.

(c) An LTI system with following relation is given,

$$y(t) = \int_{-\infty}^{t} e^{-(t-\tau)} x(\tau - 2)\, d\tau$$

i. Find h(t) for the given system.

ii. Determine y(t) if x(t) is as follows –



(6+6+6 = 18)

2. (a) During the discrete time processing of continuous time signals, the discrete time system employed has a general frequency response. With the help of appropriate mathematical representations in both time and frequency domain, describe each step, and comment on the resulting output signal.

(b) Determine whether each of the systems defined below is additive and/or homogeneous. Justify your answer by providing a proof for each property if it holds or a counterexample if it does not.

System 1 –

$$y(t) = \frac{1}{x(t)}\left[\frac{dx(t)}{dt}\right]^2$$

System 2 –

$$y[n] = \begin{cases} \dfrac{x[n]x[n-2]}{x[n-1]} , & x[n-1] \neq 0 \\ 0 , & x[n-1] = 0 \end{cases}$$

(9 × 2 = 18)

3. (a) Give the workflow for discrete time implementation of a continuous – time band – limited integrating filter to be used for the discrete time processing of continuous time signals. Plot the magnitude and phase response in each case.

(b) Considering a continuous time *Sinc* input

$$\left(\frac{\sin\left(\frac{\pi t}{T}\right)}{\pi t}\right),$$

determine the impulse response $h_d(n)$of the discrete – time filter in the implementation of the digital integrator. (9 × 2 = 18)

4. (a) Following information is given about a signal x(t) with Laplace Transform *X(s)*.

(i) x(t)is real and even.

ii. *X(s)* has four poles, no zeros in a finite s – plane.

iii. *X(s)* has a pole at .

iv. $\int_{-\infty}^{\infty} x(t)dt = 4$

Determine X(s) and ROC.