Question Paper

Exam Date & Time: 07-Dec-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH. DEGREE EXAMINATIONS - NOVEMBER / DECEMBER 2023
SUBJECT: ECE 2123- SIGNALS & SYSTEMS

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

1A) Let $x(t) = 1 + \delta(t-1) - 2\delta(t-2)$. Plot $x(t)$. Also plot $\int_0^t x(\tau)d\tau$. (4)

1B) A rectangular pulse is defined as $x(t) = \begin{cases} A, & 0 < t < T \\ 0, & otherwise \end{cases}$. $x(t)$ is applied to an integrator defined by $y(t) = \int_0^t x(\tau)d\tau$. Find the total energy of the signal $y(2t)$. (3)

1C) Given $x(t) = \begin{cases} 5-t, & 4 \le t \le 5 \\ 1, & -4 \le t \le 4 \\ t+5, & -5 \le t \le -4 \\ 0, & otherwise \end{cases}$. Plot the signal. (3)

Also plot $x(10t-5)$.

2A) The impulse response of RC filter is given by $h(t) = e^{-t}\,u(t)$. Using convolution, determine its output for the input i) $x(t) = e^{-|t|}$ ii) $x(t)$ is unity height pulse extending from t = -1 to t = 1 (4)

2B) Determine and sketch the output for a system defined by impulse response $h(n) = (0.25)\{u[n] - u[n-5]\}$ if the input is $x[n] = u[n] - u[n-10]$. (3)

2C) Sketch the block diagram representation for the following systems. The realization should be using minimum number of delay units or integrators. (3)

i) $y[n] + 2y[n-2] - 3y[n-3] = x[n-1] + 5x[n-2]$

ii) $\frac{d^2}{dt^2}y(t) - 2\frac{d}{dt}y(t) + 3y(t) = \frac{d}{dt}x(t) + x(t)$

3A) Determine convolution of the signals using Fourier representation (4)

$$x_1[n] = \left(\frac{1}{2}\right)^n u[n]$$

$$x_2[n] = \left(\frac{1}{2}\right)^n u[n]$$

(3)

3B) Determine the DTFS coefficient of the following signal using method of inspection (3)

$$x[n] = \cos\left(\frac{\pi n}{4} + \varphi\right)$$

3C) Determine the Fourier Transforms of the following signal using tables of transforms and properties (3)

$$x(t) = \frac{d}{dt} e^{-2t} u(t)$$

4A) Determine frequency response and impulse response of the system described by the following differential equation using Fourier representation (4)

$$\frac{d^2}{dt^2} y(t) + 5\frac{d}{dt} y(t) + 6y(t) = -\frac{d}{dt} x(t)$$

4B) (3)

Consider the system depicted in the Fig 4B.2 and let the Fourier transform of the input signal $x(t)$ is depicted in Fig 4B.1. Sketch $Z(j\omega)$ and $Y(j\omega)$ for $w(t) = \cos(3\pi t)$ and $h(t) = \frac{\sin(6\pi t)}{\pi t}$.

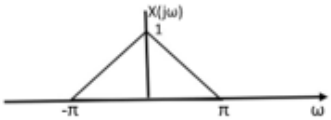

Figure 4B.1

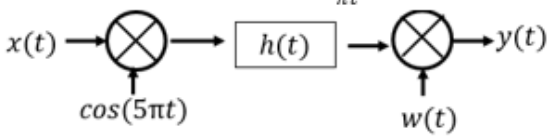

Figure 4B.2

4C) Consider the sinusoidal signal $x(t) = 3\cos(3000\pi t)$ and the sampling frequency is 2 KHz. (3)

a) Determine the expression of the sampled sequence and plot it.
b) Plot the fourier transform of the sampled sequence.

5A) For the system $H(z) = \frac{1-0.8z^{-1}+16z^{-2}}{1-\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}}$ identify the transfer function of the inverse system, and (4)

determine whether the inverse system can be both causal and stable

5B) Determine the impulse response of the system characterized by (3)

$y(n) = 2.5y(n-1) - y(n-2) + x(n) - 5x(n-1) + 6x(n-2)$ using z-transform

5C) Determine the transfer function, impulse response and the step response for the system represented by (3)

$$\frac{d^2}{dt^2} y(t) + 5\frac{d}{dt} y(t) + 6y(t) = \frac{d}{dt} x(t) + x(t)$$

using Laplace transform.

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