Exam.Code:0927
Sub. Code: 6772

1079

B.E. (Electronics and Communication Engineering)
Third Semester
EC-317: Signal and Systems

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

1. (a) Describe the examples of electrical, mechanical, and biomedical systems with the differential equations.
(b) Specify the Nyquist rate and Nyquist interval for the signal:
$$x(t) = sinc(150t) + sinc^2(150t)$$
(c) Find the inverse Fourier transform of the signal: $X(\omega) = \delta(\omega)$
(d) Determine the transfer function and impulse response for the causal LTI system described by the difference equation $y(n) - \frac{1}{2}y(n-1) = x(n) + 2x(n-1)$
(e) Describe the causality of a system in terms of its impulse response.

(5 × 2 = 10)

Section-A

2. Find whether the following systems are Memoryless, Time- Invariant, Linear, Causal, and Stable. Justify your answer. (10)
   a. $y(t) = x(t-2) + x(2-t)$
   b. $y(t) = \int_{-\infty}^{2t} x(\tau)d\tau$
   c. $y[n] = x[n]\sum_{k=-\infty}^{\infty}\delta[n-2k]$
   d. $y[n] = \log_{10}(|x[n]|)$

3. (a) The unit impulse response of an LTI system is $h(t) = e^{-t}u(t)$. Find the system's zero state response y(t) if the input signal is $x(t) = e^{-2t}u(t-3)$. (5)

(b) Use the classical method to solve (5)
$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t)$$
for the initial conditions of $y(0^+) = -\frac{1}{2}$, $\frac{dy(0^+)}{dt} = \frac{1}{2}$, and the input of $x(t) = e^{-t}u(t)$

4. (a) Consider a stable LTI system characterized by the differential equation (5)
$$\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y(t) = \frac{dx(t)}{dt} + 2x(t)$$
Find the frequency response H(ω) and the impulse response h(t) of the system.
Find the response of this system if the input $x(t) = e^{-t}u(t)$?

P.T.O.

(b) Determine the Fourier series coefficients of the signal: (5)

a. $x(n) = 1 + \sin\frac{2\pi n}{N} + 3\cos\frac{2\pi n}{N} + \cos\left(\frac{4\pi n}{N} + \frac{\pi}{2}\right)$

Section-B

5. (a) Find the Fourier Transform of the sequence $y(n) = (-1)^n a^n u(n)$, $|a| < 1$ (5)

(b) Determine all possible signals having z-transform (5)

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

6. (a) Determine the Laplace transform of the signal: (5)

$$x(t) = (1 + 0.5\sin(t))\sin(1000t)\,u(t)$$

(b) Find the final value of the signal using Z-transform: (5)

$$X(z) = \frac{2z^{-1}}{1 - 1.8z^{-1} + 0.8z^{-2}}$$

7. (a) Compute the Hilbert Transform of the signal $x(t) = sinc(2t)$ (5)

(b) Find the inverse Laplace Transform of the following: (5)

$$X(s) = \frac{2s + 5}{(s + 2)(s + 3)}$$

x-x-x