[This question paper contains **02** printed pages.]

Your Roll No.: ……

Sr. No. of Question Paper : **15052**

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 upon receipt of this question paper.
2. Attempt **five** questions in all, including **question no. 1**, which **is compulsory**.
3. Non-programmable scientific calculators are allowed.
4. **All** questions carry equal marks.

Questions

1.(a) Discuss the Eigen value and Eigen function in context with input $x(t)$ and system $h(t)$.

1.(b) Determine whether a signal $x(n) = n[u(n) - u(n-5)]$ is energy signal or power signal.

1.(c) Let x(t) be a signal with Nyquist rate ω_0. Determine the Nyquist rate for the signal $y(t)$, where $y(t) = \mathrm{x}(t)\, x(t-1)$.

1.(d) Write the Dirichlet conditions in context with Continuous time Fourier Series.

1.(e) Sketch the signal $x(2t-1)$, where $x(t) = t[u(t) - u(t-3)]$

1.(f) State Time Shifting property of continuous -time Fourier transform.

$(3 \times 6 = 18)$

2.(a) Evaluate the output y(t) of the system whose impulse response is $h(t) = [u(t) - u(t-3)]$ and input $x(t) = 5e^{-2t}u(t)$

2.(b) Consider two LTI systems with unit impulse responses $h_1(n) = [\delta(n) - 2\delta(n-2)]$ and $h_2(n) = [\delta(n) - \delta(n-1) + \delta(n-3)]$. Determine the unit impulse response equivalent of

(i) Cascade configuration of $h_1(n)$ and $h_2(n)$

(ii) Parallel configuration $h_1(n)$ and $h_2(n)$

$(9 \times 2 = 18)$

3.(a) Consider continuous periodic signals whose Fourier series representation is as follows: $x(t) = \sum_{k=0}^{100} \left(\frac{1}{2}\right)^k e^{jk\frac{2\pi}{50}t}$. Discuss whether,

(i) $x(t)$ is real or complex valued?

(ii) $x(t)$ is even or odd?

3.(b) A system is described by differential equation $\frac{dy(t)}{dt} + 2\,y(t) = 2x(t) + \frac{dx(t)}{dt}$. Find the transfer function $H(\omega)$ of the system. Also sketch its magnitude response.

(9 × 2 = 18)

4.(a) Find the inverse Z transform of $X(z) = \frac{1}{1-2z^{-1}}$ with ROC $|Z| > 2$, using contour integration method.

4.(b) Find the output of a causal system for unit step input $u(t)$. The transfer function of the system is given by $H(s) = \frac{1}{(s+0.5)(s+1)}$

(9 × 2 = 18)

5.(a) State Nyquist sampling theorem for low pass Band limited signals. Find the Nyquist rate for the signal $x\,(t) = cos\,(100\pi t) + 2sin\,(200\pi t)$.

5.(b) Write the transfer function $H(\omega)$ of a Hilbert transformer. Also, determine the unit impulse response $h(t)$ of Hilbert transformer.

(9 × 2 = 18)

6.(a) A Causal LTI system produce output $y(n) = n\left(\frac{4}{5}\right)^n u(n)$ for corresponding input $x(n) = \left(\frac{4}{5}\right)^n u(n)$. Then, determine the frequency response $H(\Omega)$ of the system.

6.(b) In a Signals and Systems class, Students of ECE-A define the unit step signal as

$$u_1(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0 \end{cases}$$

On the other hand, Student of ECE-B define the unit step signal as

$$u_2(t) = \begin{cases} 1, & t > 0 \\ 0.5, & t = 0 \\ 0, & t < 0 \end{cases}$$

(i) Comment on the applicability of both definitions of the unit step signal.

(ii) Also, mention a relation between unit step signal $u_1(t)$, unit ramp signal $r(t)$, and Dirac delta function $\delta(t)$,

(9 × 2 = 18)

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