Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering
End Sem Examination Dec-2023
EC3CO23 Signals & Systems

Programme: B.Tech. Branch/Specialisation: EC

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. A deterministic signal has- **1**

(a) No Uncertainty (b) Uncertainty

(c) Partial uncertainty (d) None of these

ii. A signal is energy signal if- **1**

(a) E = 0, P = 0 (b) E = infinite, P = finite

(c) E = finite, P = 0 (d) E = finite, P = infinite

iii. An exponential Fourier Series consists of- **1**

(a) A one-sided spectrum

(b) A two-sided spectrum

(c) Both one-sided and two-sided spectrum

(d) None of these

iv. The Fourier Transform of $e^{-5t}u(t)$ will be- **1**

(a) $\frac{1}{j\omega}$ (b) $\frac{1}{5-j\omega}$ (c) $\frac{1}{5+j\omega}$ (d) $\frac{1}{5^2-\omega^2}$

v. y(t) = x(-t) is for a- **1**

(a) Non-linear system

(b) Linear, causal and time-invariant system

(c) Linear, non-causal and time-invariant system

(d) Linear, non-causal and time-variant system

vi. For a system the input and output relation is given by a differential equation $\frac{dy(t)}{dt} + 2y(t) = x(t)$. What is the impulse response of the system? **1**

(a) u(t) (b) 2u(t) (c) $e^{-2t}u(t)$ (d) $e^{2t}u(t)$

P.T.O.

vii. If two signals $x(n) = \{\delta(n) + \delta(n+1)\}$ and $h(n) = \{\delta(n+1) + \delta(n-1)\}$ are convolved, then the number of samples in the result of convolution are- **1**

(a) 3 (b) 4 (c) 5 (d) 6

viii. Difference equation technique for higher order systems is used in- **1**

(a) Laplace Transform (b) Fourier Transform

(c) Z-Transform (d) None of these

ix. The only signal whose ROC is the entire z-plane will be- **1**

(a) $\delta(n)$ (b) u(n) (c) r(n) (d) a^n

x. The inverse z-transform of $2 + 3z^{-1} + 4z$ shall be given by- **1**

(a) [2, 3, 4] (b) [3, 4, 2] (c) [4, 2, 3] (d) [3, 2, 4]

Q.2 i. Show that the following signals are orthogonal over an interval [0, 1]: **4**

$x_2(t) = 2; x_2(t) = \sqrt{3}(1 + 2t)$

ii. Determine whether the following signals are energy signals or power signals and calculate their energy or power. **6**

(a) $\left(\frac{1}{3}\right)^n u(n)$ (b) $\cos^2 \omega t$ (c) $2e^{-4t}u(t)$

OR iii. Explain the analogy between vectors and signals. **6**

Q.3 i. Write the Dirichlet's conditions for existence of Fourier Series. What are the types of Fourier Series? **4**

ii. Explain Parseval's and Convolution Fourier Transform theorems with proof. **6**

OR iii. With the help of DTFT and Inverse-DTFT find out the output of a causal discrete LTI system which is characterised by the difference equation- **6**

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n)$$

For input $x(n) = \left(\frac{1}{4}\right)^n u(n)$.

Q.4 Attempt any two-

i. Draw the direct form-I and direct form-II structures for the differential equation, **5**

$$\frac{dy(t)}{dt} + y(t) = 5x(t)$$

ii. Find the convolution of the following signals: **5**

(a) $x_1(t) = e^{-3t}u(t); \quad x_2(t) = u(t+3)$

(b) $x_1(t) = tu(t); \quad x_2(t) = tu(t)$

iii. Check and verify the following systems are causal, time invariant and memory less or not? **5**

(a) y (t) = x (t) – x (t-2)

(b) y (t) =x^2(t)

Q.5 i. Determine whether the following systems are linear or nonlinear: **4**

$(a)\ y(n) = x(n^2)$

$(b)\ y(n) = x^2(n)$

ii. Find the total response $\{y^n(n) + y^p(n)\}$ of the difference equation, **6**

$$y(n) - \frac{2}{5}y(n-1) = 2x(n)$$

Given that the input x(n)=2u(n) and the initial condition y(0)= 0.

OR iii. Determine the response of the system characterized by the impulse response $h(n) = \left(1/2\right)^n u(n)$ to the input signal $x(n) = (n+1)\left(1/4\right)^n u(n)$. **6**

Q.6 i. Explain one-sided and two-sided z-transform with examples. **2**

ii. Explain following properties of z-transform: **8**

(a) Time shifting (b) Time reversal

(c) Differentiation (d) Final value theorem

OR iii. An LTI system is described by the equation, **8**

$$y(n) = x(n) + 0.81x(n-1) - 0.81x(n-2) - 0.45y(n-2)$$

Determine the transfer function of the system. Sketch the poles and zeros on the z-plane. Access the stability.

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