

2022

**ELECTRONICS — HONOURS**

**Paper : CC-10**

**(Signals and Systems)**

**Full Marks : 50**

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer *question no. 1* and *any four* from the rest.

1. Answer *any ten* multiple choice questions from the following : 1×10
- (a) A discrete time LTI system is causal when
    - (i) ROC is inside the outermost pole
    - (ii) ROC is outside the outermost zero
    - (iii) ROC is outside the outermost pole
    - (iv) None of the above
  - (b) Power signals can exist over
    - (i) Finite time
    - (ii) Limited time
    - (iii) Infinite time
    - (iv) All of the above.
  - (c) Which among the following systems are described by partial differential functions?
    - (i) Causal Systems and Dynamic systems
    - (ii) Distributed parameter systems and linear systems
    - (iii) Distributed parameter systems and Dynamic systems
    - (iv) Causal systems and linear systems
  - (d) ROC of a finite duration two-sided sequence is
    - (i) Entire  $z$ -plane except  $z = 0$
    - (ii) Entire  $z$ -plane except  $z = \infty$
    - (iii) Entire  $z$ -plane except  $z = \infty$  and  $z = 0$
    - (iv) At  $z = 0$  and  $z = \infty$
  - (e) Fourier series of an even function consists of
    - (i) Sine terms
    - (ii) Cosine terms
    - (iii) Both sine and cosine terms
    - (iv) Even harmonics

**Please Turn Over**

- (f) The time convolution theorem states that convolution in time domain is equivalent to
- Addition of their spectra in frequency domain
  - Subtraction of their spectra in frequency domain
  - Multiplication of their spectra in frequency domain
  - Division of their spectra in frequency domain
- (g) A causal (non-anticipative) system is a system whose output at any time  $n$  depends only on
- Present and past values
  - Present values
  - Present and future values
  - Past and future values
- (h) Any LTI system can be completely characterized in terms of its
- Unit step response
  - Unit impulse response
  - Ramp function
  - Both (i) and (ii)
- (i) A unit impulse function can be characterized by
- $\delta(n) = u(n) - u(n-2)$
  - $\delta(n) = u(n) - u(n-1)$
  - $\delta(n) = u(n) - u(n-3)$
  - $\delta(n) = u(n) - u(n+1)$
- (j) Which of the following is not Dirichlet's condition for the Fourier series expansion?
- $f(x)$  is periodic, single valued, finite
  - $f(x)$  has finite number of discontinuities in only one period
  - $f(x)$  has finite number of maxima and minima
  - $f(x)$  is a periodic, single valued, finite
- (k) A continuous-time LTI system is called causal system if its impulse response  $h(t)$  is
- Zero for  $t > 0$
  - Zero for  $t < 0$
  - Zero for  $t = 0$
  - Both (i) and (iii)
- (l) The z-transform of  $x(n) = u(-n)$  is,
- $z / (z-1)$ ; ROC :  $|z| > 1$
  - $z / (1-z)$ ; ROC :  $|z| > 1$
  - $1 / (1-z)$ ; ROC :  $|z| < 1$
  - $z / (1-z)$ ; ROC:  $|z| < 1$
2. (a) Define a unit step signal  $u(n)$ .
- (b) What is the fundamental period of the complex exponential signal  $x(t) = e^{j\omega_0 t}$ ?
- (c) Define signum function mathematically in continuous-time domain and hence sketch the waveform.
- (d) Consider a continuous-time system with input  $x(t)$  and output  $y(t)$  related by  $y(t) = x(\sin(t))$ .  
Is this system causal?

2+2+4+2

3. (a) Explain and map the relationship between s-plane to z-plane.

(b) Mention the properties of ROC.

(c) State the time scaling and time shifting property of z-transform.

5+3+2

4. (a) Explain the condition of stability for continuous time LTI system.

(b) If  $x(n) = \delta(n)$ , then check whether the following system is BIBO stable or not,  $y(n) = ax^2(n)$

5+5

5. (a) Determine the Fourier series representation of the periodic signal with time period T

$$x(t) = A \quad \text{for } 0 \leq t \leq T/2 \\ = 0 \quad \text{for } T/2 \leq t \leq T$$

(b) Explain the periodic convolution property of discrete Fourier series.

(c) What do you mean by half wave symmetry of a continuous time periodic signal?

6+3+1

6. (a) Mention the conditions for a function to have Fourier transform.

(b) Find the Fourier transform of standard signal,

(i) Impulse function  $\delta(t)$

(ii) Unit step function  $u(t)$

(c) What are the limitations of Fourier transform?

2+(3+3)+2

7. (a) Distinguish between deterministic and random signal.

(b) Find the even and odd components of the following signal,

$$x(n) = \{5, 4, 3, 2, 1\}$$

(c) Determine whether the following discrete-time signal is periodic or not

$$x(n) = \sin(2\pi n/3) + \cos(2\pi n/5)$$

3+4+3

8. (a) Check whether the following system is causal or not

$$y(n) = \sin[x(n)]$$

(b) What do you mean by shift-varying and shift-invariant system?

(c) What is stability of a discrete-time system? Define stable and unstable system.

(d) Check whether the following system is stable or not

$$h(n) = e^{3n} u(n - 2)$$

3+2+(1+2)+2