

2026

ELECTRONICS — HONOURS

Paper : DSCC-6

(Signals and Systems)

Full Marks : 75

The figures in the margin indicate full marks.

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

Group - A

1. Answer **any ten** questions : 2×10
- (a) What do you mean by symmetric and anti-symmetric signals?
 - (b) Differentiate between deterministic and nondeterministic signals.
 - (c) What is meant by an energy signal? Give one example.
 - (d) Define a causal system.
 - (e) State any two properties of an LTI system.
 - (f) What is the significance of the impulse response of an LTI system?
 - (g) Define convolution for discrete-time signals.
 - (h) State and prove the Time shifting property in Fourier transform of continuous time signals.
 - (i) Determine the ROC of the discrete time signal $x(n) = \{1, 3, 5, 6\}$.
 - (j) What is a frequency-selective filter?
 - (k) Define discrete time unit step and unit impulse signal.
 - (l) State one condition for the stability of a discrete-time LTI system in terms of ROC.

Group - B

Answer **any three** questions.

2. Classify the signal
 $x(t) = 3\cos(2\pi t) + 2$
as periodic/apperiodic, energy/power and deterministic/nondeterministic. 2+2+1
3. (a) Explain the properties of causality and linearity with suitable examples.
(b) Test whether the signal $y(t) = ax(t) + b$ is linear or non-linear. 2+3

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4. Obtain the output of an LTI system using convolution for :

$$x[n] = \{1, 1, 1\}, h[n] = \{1, 2\} \quad 5$$

5. Find the transfer function of a discrete-time LTI system described by linear constant coefficient difference equation given as,

$$y(n) = \frac{1}{2} y(n-1) + x(n) + \frac{1}{3} x(n-1). \quad 5$$

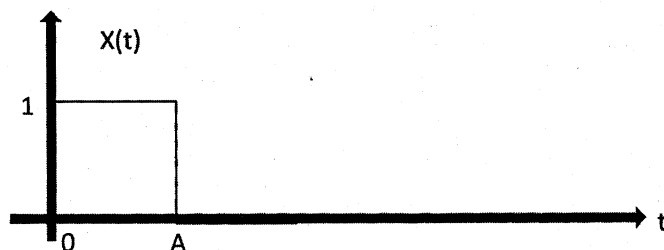
6. Find the Z-transform and ROC of

$$x[n] = a^n u[n], |a| < 1. \quad 5$$

Group - C

Answer **any four** questions.

7. (a) Find the Fourier transform of $e^{-at} u(t)$.
 (b) What do you mean by linearity of the Fourier transform?
 (c) Find the Inverse Fourier transform of $\cos \omega t$. 5+3+2
8. (a) Prove the commutative and associative properties of convolution.
 (b) Sketch the signal $x(t) = 2u(t) + tu(t) - (t-1)u(t-1) - 3u(t-2)$.
 (c) Sketch the even part of the following signal :



(2½+2½)+3+2

9. (a) Derive the convolution integral for continuous-time signals.
 (b) Determine the output of the system with impulse response

$$h(t) = e^{-t} u(t)$$

when the input is

$$x(t) = u(t). \quad 5+5$$

10. (a) Find the power and rms value of signal $x(t) = 20\cos 2\pi t$.
 (b) Find the trigonometric Fourier series for half wave rectified sine wave.
 (c) Is the output sequence of an LTI system finite or infinite when the input $x(n)$ is finite? Justify your answer. 4+5+1

11. (a) Explain the concept of Z-transform and Region of Convergence (ROC).
(b) Obtain the inverse Z-transform of

$$X(z) = \frac{z}{(z-1)(z-2)}$$

using partial fraction expansion.

- (c) Discuss the relationship between Z-transform, Fourier Transform and Laplace Transform. 2+5+3
12. (a) Define the continuous-Time Fourier Transform (CTFT).
(b) Derive the convolution property of the Fourier Transform.
(c) Explain frequency-selective filters with suitable examples. 4+3+3
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