Reg. No. : | | | | | | | | | | | |

Question Paper Code : 50960

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third Semester

Computer and Communication Engineering

EC 3354 – SIGNALS AND SYSTEMS

(Common to Electronics and Communication Engineering/Electronics and Telecommunication Engineering and Medical Electronics)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define continuous and discrete time signals.

2. Distinguish between deterministic and random signals.

3. Write the pair equations of the Fourier series of a periodic continuous time signals.

4. Recall the initial and final value theorems of Laplace transform.

5. Define impulse response.

6. State the condition for an LTI system to be stable.

7. What is aliasing?

8. State any two properties of DTFT.

9. Differentiate between recursive and non-recursive systems.

10. List the condition for an LTI system to be causal.

PART B — (5 × 13 = 65 marks)

11. (a) Describe the following signals with their graphical and mathematical representations.

(i) Step (2)

(ii) Ramp (2)

(iii) Impulse (2)

(iv) Pulse (2)

(v) Real exponentials (3)

(vi) Sinusoids (2)

Or

(b) How do you classify the discrete time systems based on their properties? Describe the property of each category. (13)

12. (a) (i) Determine the Fourier series representation of $x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$. (7)

(ii) Find the Fourier transform of the signal $x(t) = e^{2t}u(-t)$. (6)

Or

(b) (i) Determine the Laplace transform of $x(t) = e^{at}u(t)$, and depict the ROC and the locations of poles and zeros in the s-plane. Assume that a is real. (7)

(ii) Determine the function of time $x(t)$ for the following Laplace transform and its associated region of convergence. (6)

$$\frac{s+1}{s^2+5s+6}, \; -3 < \mathrm{Re}\{s\} < -2 .$$

13. (a) Derive the equation of convolutional integral and summarize the evaluation procedure of convolution integral. (13)

Or

(b) (i) The input and output of a stable and causal LTI system are related by the differential equation $\frac{d^2y(t)}{dt^2} + \frac{6dy(t)}{dt} + 8y(t) = 2x(t)$. Find the impulse response of this system. (7)

(ii) A system has the transfer function $H(s) = \frac{2s-1}{s^2+2s+1}$

Determine the impulse response assuming

(1) that the system is causal. (3)

(2) that the system is stable. (3)

14. (a) (i) State and prove sampling theorem. (8)

(ii) Compute the DTFT of the signal $x(n) = a^{|n|}$, $|a| < 1$. (5)

Or

(b) (i) Determine the z-transform and ROC of the signal $x(n) = 3^n u(-n-1)$. (7)

(ii) Obtain the time domain signal corresponding to the z-transform (6)

$$X(z) = \frac{1 + \frac{7}{6} z^{-1}}{\left(1 - \frac{1}{2} z^{-1}\right)\left(1 + \frac{1}{3} z^{-1}\right)}, \ |z| > \frac{1}{2}.$$

15. (a) Evaluate the discrete time convolution sum of the following.

$$y(n) = \left(\frac{1}{4}\right)^n u(n) * u(n+2).$$ (13)

Or

(b) Determine the transfer function and the impulse response for the causal LTI system described by the difference equation. (13)

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

PART C — (1 × 15 = 15 marks)

16. (a) (i) Determine whether the continuous time signal $x(t) = 3\cos\left(4t + \frac{\pi}{3}\right)$ is periodic? If the signal is periodic, determine its fundamental period. (8)

(ii) Categorize the following signal as an energy signal or a power signal, find the energy or time-averaged power of the signal

$$x(t) = \begin{cases} t, & 0 \le t \le 1 \\ 2-t, & 1 \le t \le 2 \\ 0, & otherwise \end{cases}$$ (7)

Or

(b) Determine whether the system $y(n) = nx(n)$ is

(i) Memoryless (3)

(ii) Time invariant (3)

(iii) Linear (3)

(iv) Causal (3)

(v) Stable (3)