B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Third Semester

Electronics and Communication Engineering

(Common to Computer and Communication Engineering)

20ECPC303 - SIGNALS AND SYSTEMS

Regulations - 2020

Duration: 3 Hours   Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)
Answer ALL Questions

		Marks	K–Level	CO
1.	Which of the following is an example of an energy signal? (a) Sinusoidal signal (b) Unit step signal (c) Exponential decay signal (d) Ramp signal	1	K1	CO1
2.	A system is said to be causal if: (a) Output depends only on future inputs (b) Output depends on both past and future inputs (c) Output depends only on past and present inputs (d) Output depends only on the present input	1	K2	CO1
3.	Fourier series representation exists only for: (a) Aperiodic signals (b) Periodic signals (c) Random signals (d) All signals	1	K2	CO2
4.	Which of the following is not a property of continuous-time Fourier series? (a) Time Shifting (b) Linearity (c) Multiplication in time domain (d) Sampling property	1	K1	CO2
5.	The Laplace Transform is particularly useful for analyzing: (a) Random signals (b) Periodic signals only (c) Systems described by differential equations (d) Discrete signals	1	K2	CO3
6.	Which property of the Fourier Transform states that a time shift in the signal corresponds to a phase shift in the frequency domain? (a) Linearity (b) Duality (c) Time Shifting (d) Convolution	1	K1	CO3
7.	The output y(t) of a Linear Time-Invariant (LTI) system can be determined by: (a) Differentiating the input signal (b) Applying Fourier series (c) Convolution of input with impulse response (d) Multiplying input with transfer function	1	K1	CO4
8.	Find the Fourier transform of $h(n) = \delta(n - n_0)$. a) $e^{-j\omega n_0}$ b) $e^{j\omega n_0}$ c) $e^{-j2\omega n_0}$ d) $e^{j2\omega n_0}$	1	K2	CO4
9.	Which of the following transforms is suitable for analyzing discrete-time causal LTI systems? (a) Laplace Transform (b) Continuous Time Fourier Series (c) Discrete Time Fourier Transform (d) Z-Transform	1	K1	CO5
10.	The minimum number of delay elements required in realizing a digital filter with the transfer function $H(z) = \dfrac{1 + az^{-1} + bz^{-2}}{1 + cz^{-1} + dz^{-2} + ez^{-3}}$ is a) 2 b) 3 c) 4 d) 5	1	K2	CO6

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

11.	Define and sketch the unit step and unit impulse signals.	2	K2	CO1
12.	Classify systems based on linearity and causality with suitable examples.	2	K2	CO1
13.	Write the trigonometric form of the Fourier series.	2	K1	CO2

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **14081**

14.	State the Dirichlet's conditions of Fourier series.	2	K1 CO2
15.	State time-scaling and time-shifting properties of the Fourier Transform.	2	K2 CO3
16.	Consider the LTI system with transfer function $H(S) = 1 / [(s+1)(s+3)]$ Re(s)>3, determine h(t).	2	K2 CO3
17.	What is the convolution integral? Write its mathematical expression for LTI systems.	2	K2 CO4
18.	A continuous-time LTI system is described by the differential equation $dy(t)/dt + 2y(t) = x(t)$ Find the impulse response h(t) of the system.	2	K2 CO4
19.	Define sampling. What is the Nyquist rate?	2	K2 CO5
20.	List any four properties of Discrete-Time Fourier Transform (DTFT).	2	K1 CO5
21.	What is the convolution sum? Write the formula used for computing the output of a discrete LTI system.	2	K2 CO6
22.	Differentiate between recursive and non-recursive systems with one example each.	2	K2 CO6

PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

23. a) For the given systems (1) $y(t) = at^2 x(t) + btx(t-4)$ (2) $y[n] = \log_{10}|x[n]|$. | 11 | K2 CO1 |

Use suitable procedure to determine the systems has the following properties.
(i) Linear or non-linear   (ii) Time variant or invariant   (iii) Causal or not

OR

   b) Sketch the following signals (1) u(-t+2); (2) r(-t+3); (3) 2 δ[n+2]+ δ[n]-2 δ[n-1]+3 δ[n+3] ; (4) u[n+2]u[-n+3] where u(t), r(t), δ[n], u[n] represent continuous time unit step, continuous time ramp, discrete time impulse and discrete time step functions respectively. | 11 | K2 CO1 |

24. a) Express the trigonometric Fourier Series representation for the periodic signal shown in figure. | 11 | K2 CO2 |
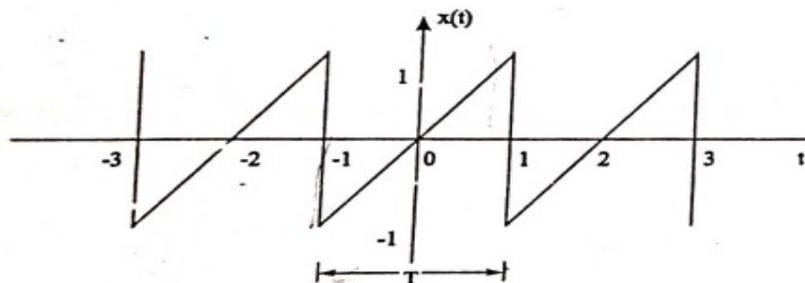
OR

   b) State and prove any five properties of Fourier series. | 11 | K2 CO2 |

25. a) Determine the initial and final values, if they exist for the signal with Laplace transform $X(s) = \dfrac{s+4}{(s^2 + 3s + 5)}$. | 11 | K3 CO3 |

OR

   b) Apply Fourier transform to determine the convolution of the signal $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-4t}u(t)$. | 11 | K3 CO3 |

26. a) Using Laplace transform solve the following differential equation 11 $K3$ $CO4$
$$\frac{d^2 y(t)}{dt} + 6\frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + 2x(t) \text{ for } \text{ input } x(t) = e^{-t}u(t) \text{ with } \text{ initial }$$
conditions $y(0^+) = 2$ and $\frac{dy(0^+)}{dt} = 3$.

OR

b) A stable LTI system is characterized by the differential equation 11 $K3$ $CO4$

$$\frac{d^2}{dt^2}y(t) + 3\frac{d}{dt}y(t) + 2y(t) = 2x(t).$$

Find the frequency response and impulse response using Fourier transform.

27. a) Using properties of DTFT, Express the DTFT of the signal 11 $K2$ $CO5$

$(i)u[n+4] - u[n-4]$ $\qquad (ii)x[n] = \left(\frac{1}{2}\right)^n u[n+1]$

OR

b) Represent the Z transform and the ROC of the following sequences: 11 $K2$ $CO5$
(i) x(n) = sin(ω_0n)u(n)
(ii) x(n) = -a^n u(-n-1) .

28. a) Determine the complete response of the system described by the difference 11 $K3$ $CO6$
equation using Z-Transform $y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with
y(-1)=0 and y(-2)=1.

OR

b) Find the direct form I and direct form II of system described by the difference 11 $K3$ $CO6$
equation y(n)= 0.75y(n-1)-0.125y(n-2) + x(n) +7x(n-1) + x(n-2).