Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May / June 2026

Date: 27-05-2026 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B.Tech	
Course Code: ECE3028	**Course Name:** Speech Signal Processing	
Semester: VI	**Max Marks**: 100	**Weightage:** 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5	CO6
Marks	14	14	12	16	24	20

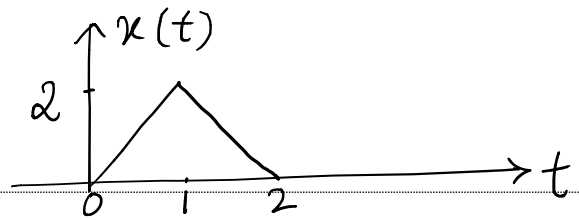
Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	**A speech signal is a continuous (analog) sound wave produced by the human vocal tract that carries linguistic information, characterized by air pressure fluctuations varying in amplitude over time. Consider the following analog speech signals $x_1(t) = \cos 20\pi t$ and $x_2(t) = \cos 100\pi t$. If the signals are sampled at a rate of 40 Hz, write the expressions for the respective discrete time sequences $x_1[n]$ and $x_2[n]$.**	**2 Marks**	**L1**	**CO1**
2.	**A discrete-time speech signal captures amplitude values at discrete instants rather than continuously. This format allows computers to process speech, which is generally non-stationary. For the discrete time speech signal $x_1[n] = \{1, 3, -2, 0, 1, 2\}$, draw $x_1[n-2]$. (take -2 as the n=0 sample)**	**2 Marks**	**L1**	**CO1**
3.	**A continuous-time speech signal is an analog, real-world sound wave, that is defined at every instant of time, characterized by continuous amplitude variations over time. For the following approximated speech signal draw $x_1(t-2)$** 	**2 Marks**	**L2**	**CO2**

4.	**The Dirac delta function δ(t) is defined as zero everywhere except at t = 0, where it is infinite, and its integral equals one. Convert the discrete-time speech signal $x_1[n] = \{1, -2, 1, 2, 3, -2\}$ to Z-transform expression. (take 2 as the n=0 sample)**	**2 Marks**	**L1**	**CO2**
5.	**A discrete-time speech signal is a digital representation of analog speech, created by sampling continuous audio at specific, regular intervals. For the discrete time speech signal $x_1[n] = \{-1, 0, 1, -2, 0, 1, 3\}$, draw $x_1[2n]$. (take -2 as the n=0 sample)**	**2 Marks**	**L2**	**CO3**
6.	**Analog signals have continuous amplitude and time, meaning they can have an infinite number of values within a range. What is an even and an odd signal. Give example using a discrete time speech signal graph.**	**2 Marks**	**L1**	**CO4**
7.	**The Region of Convergence (ROC) is the set of points in the complex plane (s-plane for Laplace, z-plane for Z-transform) where a transform summation converges to a finite value. Find the Region of Convergence (ROC) of *x(n)* =$(-1)^n u(n)$. and draw the ROC.**	**2 Marks**	**L2**	**CO4**
8.	**A continuous time speech signal is converted to a discrete-time signal by taking samples at a sampling rate. Write the expression for the even and odd signal of a dicrete time speech signal.**	**2 Marks**	**L2**	**CO4**
9.	**An analog speech signal is a continuous, time-varying electromagnetic or acoustic wave representing human speech, where amplitude and frequency correspond directly to sound volume and pitch. Consider the following analog speech signals $x_1(t) = \cos 20\pi t$ and $x_2(t) = \cos 100\pi t$. convert them into corresponding Laplace Transforms.**	**2 Marks**	**L2**	**CO5**
10.	**Discrete-time processing of speech is the analysis, manipulation, and synthesis of speech signals represented as a sequence of numbers (samples) rather than a continuous wave. Express the discrete time speech signal $x_1[n] = \{1, -2, 1, 2, 3, -2\}$ in terms of shifted delta function. (take 2 as the n=0 sample)**	**2 Marks**	**L2**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

11.		**Consider the analog speech signal $x_1(t) = 5\sin 120\pi t + 3\sin 100\pi t + 2\sin 200\pi t$.** **(i) Determine the minimum sampling rate required to avoid aliasing.** **(ii) Suppose that the signal is sampled at the rate *Fs* = 300 Hz. What is the discrete-time signal obtained after sampling?**	**10 Marks**	**L2**	**CO1**
		Or			
12.		**Consider the analog speech signal $x_1(t) = 2\cos 150\pi t$** **(i) Determine the minimum sampling rate required to avoid aliasing.** **(ii) Suppose that the signal is sampled at the rate *Fs* = 65 Hz. What is the discrete time signal obtained after sampling?**	**10 Marks**	**L3**	**CO1**

13.		**If a discrete time speech signal x[n]= {3,0,3} (take 0 as the n=0 sample) passes through a filter with impulse response h[n] = {-2,0,2} (take 0 as the n=0 sample) find the output of the filter using Discrete time**	**10 Marks**	**L3**	**CO2**

		Fourier Transform. Write the output in time domain. Also verify with tabular method.			
		Or			
14.		**Speech production is the cognitive and physical process of turning thoughts into spoken language, involving conceptualization, word selection, and motor planning, followed by the coordination of muscles in the vocal tract. Discuss the process of speech production using block diagram.**	**10 Marks**	**L2**	**CO2**

15.		**Convolution is a mathematical operation that combines two functions (or signals) to produce a third, representing how one function modifies the other. If a discrete time speech signal x[n]= {-1,0,1} (take 0 as the n=0 sample) passes through a filter with impulse response h[n] = {-2,0,2} (take 0 as the n=0 sample) find the output of the filter using Z-Transform. Write the output in time domain. Also verify with tabular method.**	**10 Marks**	**L3**	**CO3**
		Or			
16.		**Find the z-transform expression and the corresponding Region of Convergence (ROC) when the input speech sequence is** $x(n) = (-\frac{1}{2})^n u(n)$.	**10 Marks**	**L2**	**CO3**

17.		**For the filter system described by the second-order difference equation** $y(n) - 2y(n-1) - 8y(n-2) = x(n) - 3x(n-1)$ **(i) Write the corresponding Z- Transform expressions for both input and the difference equation.** **(ii) Find the corresponding Transfer function using Z-Transform.**	**10 Marks**	**L4**	**CO4**
		Or			
18.		**For the filter system described by the second-order difference equation** $y(n) - 3y(n-1) - 8y(n-2) = x(n) - 3x(n+1)$ **(i) Write the corresponding Z- Transform expressions for both input and the difference equation.** **Find the corresponding Transfer function using Z- Transform.**	**10 Marks**	**L4**	**CO4**

19.		**Determine the response** $y(n)$, $n > 0$, **of the system described by the second-order difference equation** $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$ **when the input sequence is** $x(n) = 4^n u(n)$, **for** $y(-2)=0$, $y(-1)=5$. **Also find the homogeneous and particular solution for the same.**	**20 Marks**	**L2**	**CO5**
		Or			

20.		**Determine the response *y(n), n* > 0, of the system described by the second-order difference equation** **y(n) - 9*y(n* - 1) + 14y(n - 2) = 0** **for y(-2)=0, y(-1)=5.** **Also find the homogeneous and particular solution for the same.**	**20 Marks**	**L4**	**CO5**

21.		**Discrete-time signal operations are used to analyze speech signals represented for signal processing. For the following discrete time speech signal $x_1[n]$= {1,-2,3,0,3,-2,1} (take 0 as the n=0 sample)** **Draw $x_1[n]$, $x_1[n-2]$, $x_1[2n]$**	**20 Marks**	**L4**	**CO6**
Or					
22.		**Discrete-time signal operations are used to analyze speech signals represented for signal processing. For the following discrete time speech signal $x_1[n]$= {1,3,-2,3,1} (take -2 as the n=0 sample)** **Draw $x_1[n]$, $x_1[n+1]$, $x_1[n/2]$**	**20 Marks**	**L4**	**CO6**