UPES
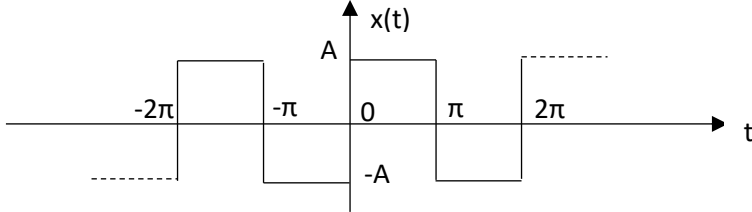**End Semester Examination, December 2023**

Course: Signal and Systems   Semester: III
Program: B. Tech. (ECE/Mechatronics)   Time   : 03 hrs.
Course Code: ECEG2010   Max. Marks: 100

Instructions: Attempt all the Questions

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Determine whether the following signals are periodic or not? If they are periodic determine the fundamental period. (a) $x(t) = cos2t + sin\sqrt{3}t$ (b) $x(n) = 1 + e^{j2\pi n/3} - e^{j4\pi n/7}$	4	CO1
Q 2	Estimate the even and odd components of the following signals: (a) $x(t) = sin2t + sin2tcos2t + cos2t$ (b) $x(t) = 1 + 2t + 3t^2 + 4t^3$	4	CO1
Q 3	Determine whether the following signals are energy or power signals and calculate their energy or power: $x(t) = Ae^{-at}u(t), \quad a > 0$	4	CO2
Q 4	Find the discrete time Fourier transform of the following sequence: $x(n) = (0.5)^n u(n) + 2^n u(-n-1)$	4	CO4
Q 5	State and prove the following properties of the Z-transform (a) Time Reversal property (b) Time Expansion property	4	CO4

SECTION B
(4Qx10M= 40 Marks)

| Q 6 | The system is described by the following equation:
 $$y(t) = atx(t) + bt^2x(t-2)$$
 Analyze the following properties of the system:
 (i)   Static or Dynamic
 (ii)   Linear or non-linear | 10 | CO3 |

	(iii) Causal or non-causal (iv) Time-invariant or time-variant		
Q 7	Find the Fourier transform of the following signals: (a) $x(t) = e^{-a|t|}sgn(t)$ (b) $x(t) = \begin{cases} 1 + cos\pi t, & |t| < 1 \\ 0 & , |t| > 1 \end{cases}$	10	CO2
Q 8	Determine the trigonometric Fourier series for the waveform shown in figure 1. **Figure 1**	10	CO4
Q 9	A signal $x(t) = 2cos400\pi t + 6cos640\pi t$ is ideally sampled at $f_s = 500Hz$. If the sampled signal is passed through an ideal low pass filter with a cutoff frequency of 400Hz, what frequency components will appear in the output? Sketch the output spectrum and also find the output signal.	10	CO2
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	(a) The impulse response of a LTI system is $h(n) = \{1, 2, 1, -2\}$. Find the response of the system for the input $x(n) = \{1, \ 3, \ 2, \ 1\}$. (b) Determine the convolution of the following signals using discrete time Fourier transform. $$x_1(n) = \left(\frac{1}{2}\right)^n u(n)$$ $$x_2(n) = \left(\frac{1}{3}\right)^n u(n)$$	20	CO3
Q 11	(a) A causal LTI system is described by the difference equation $$y(n) = y(n-1) + y(n-2) + x(n) + 2x(n-1)$$ Determine the system function and frequency response of the system. Plot the poles and zeros and indicate the ROC. Also estimate the stability and impulse response of the system. (b) Determine the inverse Z-transform of the following using residue method. $$X(z) = \frac{1 + 2z^{-1}}{1 + 4z^{-1} + 3z^{-2}}; ROC; |z| > 3$$	20	CO4