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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, DEC 2024

ELECTRONICS AND COMMUNICATION ENGINEERING
Semester 3
EC23302 SIGNALS AND SYSTEMS
(Regulation2023)

Time:3hrs Max.Marks: 100

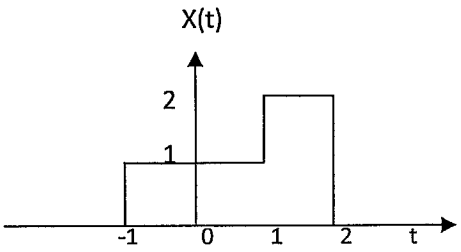
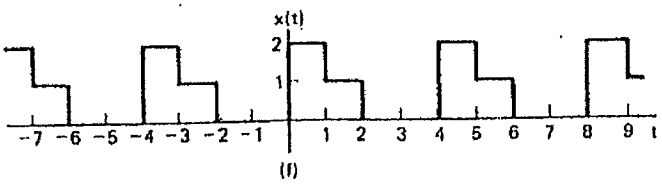
CO1	Ability to classify signals and systems based on various characteristics and decomposition for easier analysis
CO2	Ability to determine analyze frequency components of signals and frequency response of the systems.
CO3	Ability to determine and analyze the causality and stability LTI systems from their impulse responses
CO4	Ability to convert the CT signals into DT signals and analyze, the effect of sampling and frequency content of DT signals.
CO5	Ability to analyze the processing of random signals with LTI systems

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)
(Answer all Questions)

Q.No	Questions	Marks	CO	BL
1	Plot the signals δ(t) and u(t-1).	2	1	2
2	Find whether the given signal $x[n] = e^{-j\frac{\pi n}{3}}$ is periodic or not. If periodic, find the fundamental period.	2	1	2
3	State the Dirichlet's conditions for the convergence of Fourier transform.	2	2	1
4	Given the Fourier series coefficients of a periodic signal x(t) with period T=4 sec as $a_k = \begin{cases} (k)^2 & ; k = 1,2 \\ 0 & ; other\ wise \end{cases}$. Determine x(t).	2	2	3
5	Determine the signal x(t), given that it's Laplace transform $X(s) = \frac{1}{(s+3)^2}; Re\{s\} > -3$.	2	3	3
6	Consider that a causal LTI system is described by the differential equation, $\frac{dy(t)}{dt} + 3y(t) = 2x(t)$. Determine the transfer function H(s) of the system.	2	3	3
7	What is meant by the term 'Aliasing' in sampling process?	2	4	2
8	Determine the minimum sampling frequency required to sample the signal $x(t) = 2\sin 250\pi t + cos350\pi t$	2	4	2
9	State central limit theorem.	2	5	1
10	Let X and Y are random variables with mean values 4 and 9 respectively. If Z=3X+Y is a random variable, determine the mean value of Z.	2	5	2

PART- B(5x 13=65Marks)

Q.No.	Questions	Marks	CO	BL
11 (a)	i) Consider the signal x(t) as given in figure.  Determine the signals x(t-3), x(2t-2) and, even and odd parts of x(t) ii) Determine the energy and power of the signal, $x[n] = \left(\frac{1}{2}\right)^n u[n]$.	10 3	1	4
	OR			
11 (b)	i) Classify the following system under linearity, time invariance, causality and memory (static/dynamic) $y(t) = tx(t-5)$ ii) Sketch the signal $x[n] = (u[n] - 2u[n-4] + u[n-8])\, r[n]$	8 5		
12 (a)	i) Consider the signal x(t) and determine the Fourier series coefficients  (f) ii) Find Fourier series coefficients for the signal $x(t) = 2\cos(100\pi t) + 3\sin(50\pi t)$	10 3	2	4
	OR			
12 (b)	Consider a stable and causal LTI system described by, $\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} - 12\,y(t) = 2\,x(t) + \frac{dx(t)}{dt}$. i) Determine frequency response. ii) Determine impulse response h(t) and the response of the system y(t) for the input $x(t) = 2e^{-3t}u(t)$	 3 10		
13 (a)	i) Determine the inverse Laplace transform of the signal, $X(s) = \frac{1}{(s+2)^2+9}; Re\{s\} > -2$ ii) Plot the signal $x(t) = e^{-a\|t\|}$ and determine the Laplace transform for A) a>0 and B) a<0	3 10	3	3
	OR			

13 (b)	Consider a LTI system with system function $H(s) = \frac{2+s}{s^2+11s-12}$. i) Write the differential equation relating the input x(t) and output y(t) of the system ii) Draw the pole zero plot. Determine all possible impulse response of the system and comment on system characteristics.	3 10		
14 (a)	i) Explain the ideal sampling process in time domain and its frequency domain impact. ii) Consider a signal $x(t) = 2cos(200\pi t) + sin(300\pi t)$ is sampled using periodic impulse train of period T_s=2 ms. Plot the spectrum of $x(t)$ and its sampled version.	7 6	4	3
	OR			
14 (b)	i) Explain the sampling of continuous time signal using flat top sampling. ii) Consider a DT signal $x_\delta(t)$ is obtained by sampling the signal $x(t) = 2\,cos(2\pi f_o t)$ at a rate of 3000 samples/s. The sampled signal $x_\delta(t)$ is passed through an ideal low pass filter with cut off frequency of 1500 Hz. Then, determine and plot the signal coming out of the LPF if A) f_o=1200 Hz, B) f_o=1800 Hz.	7 6		
15 (a)	i) Consider that WSS process X(t) is transmitted through a LTI system with impulse response h(t) and produces the output process Y(t). Derive the relationship between the mean and auto correlation function of input and output processes. ii) Let a signal X(t) with auto correlation function $R_X(\tau) = cos(4\pi\tau)$ is passed through a system with frequency response $H(\omega) = j\omega$ to produce output signal Y(t). Determine the power spectral density of system output.	9 4	5	2
	OR			
15 (b)	i) State the properties of autocorrelation function. ii) Consider a random process $X(t) = Acos(\omega t + \Theta)$, where A and ω are constants and Θ is uniformly distributed random variable over $[-\pi, \pi]$. Verify whether $X(t)$ is Wide Sense Stationary process or not.	4 9		

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	Consider two LTI systems with impulse responses $h_1(t) = \delta(t-2)$ and $h_2(t) = e^{-2t}u(t)$. (i) Determine overall impulse response of resultant system if they are connected in A) series, B) Parallel (ii) Determine transfer function and the differential equations of those describe the systems identified in (i).	7 8	3	5