Model Question Paper-2 with effect from 2019-20 (CBCS Scheme)

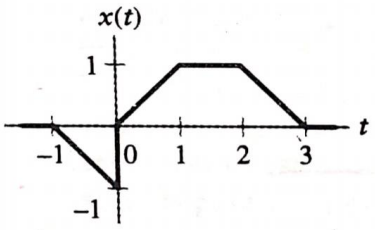
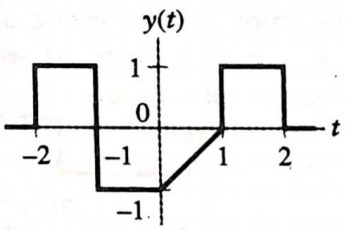
USN | | | | | | | | | | |

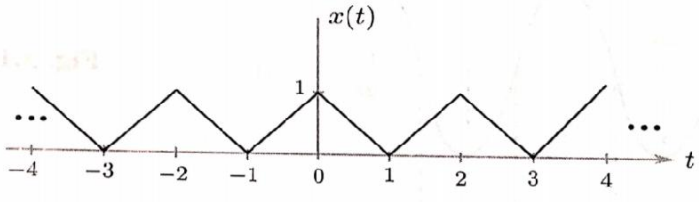
Fourth Semester B.E. Degree Examination

Signals and Systems

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Short forms used take usual meaning.
03. Missing data may be suitably assumed.

		Module -1	***Bloom's Taxonomy Level**	**Marks**
Q.01	a	Given the signal $x[n] = (8-n)(u[n] - u[n-7])$, sketch the following signals: (i) $y[n] = x[4-n]$ (ii) $g[n] = x[-2n+3]$	L2	4 Marks
	b	Calculate the Energy and Power of the following signals: (i) $x(t) = e^{-0.05t}[u(t) - u(t-10)]$ (ii) $x[n] = u[n]$ (iii) $x(t) = 5\cos(200\pi t)$ (iv) $x[n] = (-2)^n[u(n+1) - u(n-2)]$	L3	10 Marks
	c	Find whether the following signals are periodic or not. If periodic, find the fundamental period. (i) $x(t) = \sin^2(400\pi t)$ (ii) $x(t) = \cos(2t) + \sin(3t)$ (iii) $x(t) = \sin(4\pi t) + \sin(5t)$	L2	6 Marks
		OR		
Q.02	a	Fig. Q2(a) shows two signals x(t) and y(t). Sketch the following signals. (i) $x(t)\,y(t-1)$ (ii) $x(t+1)\,y(t-2)$ (iii) $x(t)\,y(-1-t)$ (iv) $x(4-t)\,y(t)$  Fig. Q2(a)-(i)  Fig. Q2(a)-(ii)	L3	10 Marks
	b	Evaluate the expression, $\int_1^2 t^2\,\delta(2t-3)dt + \int_{-3}^{3}\delta(3t+5)\,dt$	L2	4 Marks
	c	Given the signal, $x(t) = r(t+5) - r(t+4) - r(t-4) + r(t-5)$, sketch x(t) and its derivative.	L3	6 Marks
		Module-2		
Q. 03	a	Determine whether the following system represented by input-output relation, is (i) Stable (ii) Memoryless (iii) Causal (iv) Time-invariant and (v) Linear: $y(t) = \int_{-\infty}^{t} x(\tau)\,d\tau$	L2	6 Marks

	b	Following represents the input-output relations of various systems. Determine whether they are invertible or not: (i) $y[n] = n\,x[n]$ (ii) $y(t) = x(2t+3)$ (iii) $y[n] = \sum_{k=-\infty}^{n} x[k]$ If Invertible, represent the Inverse system.	L2	6 Marks
	c	Let $x[n] = u[n] - u[n-5]$, be the input signal applied to a Linear and Time-Invariant (LTI) discrete-time system and $h[n] = \alpha^n\,(u[n] - u[n-7])$, be the impulse response of the system. Obtain the output signal, y[n].	L3	8 Marks
		OR		
Q.04	a	Perform convolution operation on the following signals: $x_1(t) = e^{-\lvert t-2\rvert}$ and $x_2(t) = e^{-2t}u(t+4)$	L3	8 Marks
	b	Given $x[n] = \{1, 2, 3, -2\}$, here sample-value 2 appears at time-origin, and $h[n] = \delta[n+1] - 2\delta[n] + 3\delta[n-1]$. Obtain y[n] = x[n]*h[n].	L3	4 Marks
	c	Determine whether the following systems represented by input-output relations are stable and causal: (i) $y[n] = x[n]\,u[n+1]$ (ii) $y(t) = x(\sin t)$ (iii) $y[n] = \cos(x[n])$ (iv) $y(t) = t\,x(t)$	L2	8 Marks
		Module-3		
Q. 05	a	Given the impulse response, h[n], of an LTI system, obtain the condition which needs to be satisfied by h[n], for the system to be (i) causal (ii) stable.	L2	4 Marks
	b	The signal, $h(t) = u(t) - 2\,u(t-1) + u(t-2)$, represents impulse response of an LTI system. Obtain the step response of the system.	L3	6 Marks
	c	Find the complex Fourier Series coefficients X(k) for the waveform shown in the Fig.Q5(c). Sketch magnitude and phase spectra.  Fig. Q5(c)	L3	10 Marks
		OR		
Q. 06	a	State and prove the following properties of Continuous-Time Fourier Series: (i) Frequency shifting (ii) Time differentiation	L2	6 Marks
	b	For a periodic signal x(t), magnitude and phase spectral sample values are given below in the table Q6(b). They take zero values for other values of k. Determine the signal x(t), whose fundamental frequency, $\omega_0 = \pi$ rad/sec. Table Q6(b)	L3	6 Marks
	c	Determine whether the following systems represented by impulse responses are stable and causal: (i) $h[n] = u[n-1] - u[n-5]$ (ii) $h[n] = 0.5^{\lvert n\rvert}$ (iii) $h(t) = e^{-t}u(-t)$ (iv) $h(t) = u(t-1)$	L2	8 Marks

k	-2	-1	0	1	2
|X(k)|	2	1	1	1	2
θ(k)	-π/8	π/4	0	π/4	π/8

		Module-4		
Q. 07	a	Show that for a real-valued aperiodic signal x(t), the real part of its Fourier transform is an even function of frequency and the imaginary part is an odd function of frequency.	L2	6 Marks
	b	State and prove the following properties with respect to DTFT: (i) Frequency differentiation (ii) Time-domain Convolution	L2	6 Marks
	c	Find the Fourier Transform of the following signals: (i) $x(t) = \delta(t+1) - \delta(t-1)$ (ii) $x(t) = \frac{d}{dt}[te^{-2t}\sin t\, u(t)]$	L3	8 Marks
		OR		
Q. 08	a	Find the DTFT of $x[n] = a^{\lvert n\rvert}, \lvert a\rvert < 1$. Also, sketch the magnitude and phase spectra.	L3	6 Marks
	b	State and prove the following properties with respect to continuous-time Fourier transform: (i) Time scaling (ii) Integration	L2	6 Marks
	c	The DTFT of a real signal is $X(e^{j\Omega})$. Express DTFT of each of the following signals in terms of $X(e^{j\Omega})$: (i) $x[-n]$ (ii) $x[n] * x[-n]$ (iii) $(-1)^n x[n]$ (iv) $(1+\cos n\pi)x[n]$	L3	8 Marks
		Module-5		
Q. 09	a	What is Region of Convergence (ROC) of Z-Transform? Mention its properties.	L1	6 Marks
	b	Determine the z-transform and ROC for the following time signals. Sketch the ROC, poles and zeroes in the z-plane. (i) $x[n] = 2^n \sin\left(\frac{\pi}{4}n\right) u[-n]$ (ii) $x[n] = \left(\frac{1}{4}\right)^n (u[n] - u[n-N])$	L3	8 Marks
	c	Find the Inverse Z-transform of $X(z) = \frac{z^4+z^2}{z^2-0.75z+0.125}$, ROC: $\lvert z\rvert > 0.5$, using partial fraction method.	L3	6 Marks
		OR		
Q. 10	a	A discrete LTI system is characterized by following Difference equation: y[n] = y[n-1] +y[n-2] +x[n-1] (i) Find the system function. (ii) Indicate ROC if system is stable. (iii) Indicate ROC if system is causal. (iv) Obtain impulse response in both cases.	L3	10 Marks
	b	State and prove the following properties of Z-transform: (i) Time-reversal (ii) Multiplication by exponential function	L2	4 Marks
	c	Find the Z-transform of the following signals: (i) $x[n] = 2^n u[-n-3]$ (ii) $x[n] = \sin\left(\frac{\pi n}{8} - \frac{\pi}{4}\right) u[n-2]$	L3	6 Marks

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.