Model Question Paper-1 with effect from 2019-20 (CBCS Scheme)

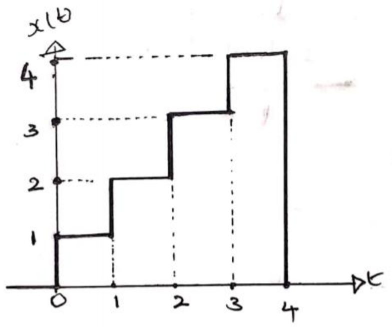
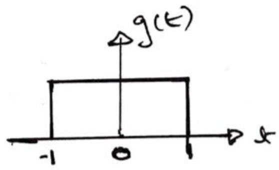
USN

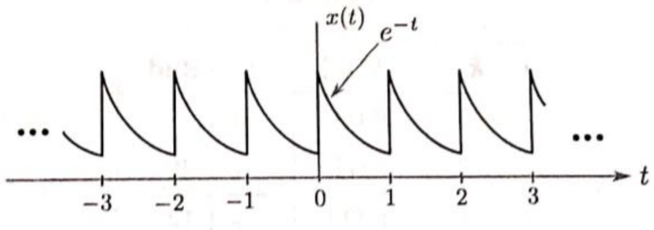
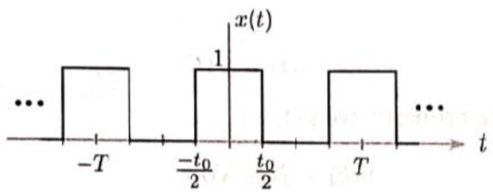
Fourth Semester B.E. Degree Examination

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	Distinguish between (i) Periodic and Non-periodic signals (ii) Deterministic and Random signals.	L1	4 Marks
	b	Determine and sketch the even and odd components of the following signals: (i) $x[n] = \begin{cases} -2 + n^2, & -1 \le n \le 3 \\ 0, & \text{otherwise} \end{cases}$ (ii) $x(t) = \begin{cases} 2t, & 0 < t < 1 \\ 2(2-t), & 1 < t < 2 \end{cases}$	L2	8 Marks
	c	Sketch and determine the energy of the following signals: (i) $x(t) = r(t+1) - r(t) - r(t-2) + r(t-3)$ (ii) $x[n] = -u[n-1] + u[n-5]$	L3	8 Marks
		OR		
Q.02	a	Two signals x(t) and g(t) are shown in Fig.Q2(a). Express the signal x(t) in terms of g(t). Fig. Q2(a)-i Fig. Q2(a)-ii	L3	8 Marks
	b	Determine whether each of the following signals is periodic or not: If periodic, find the fundamental period: (i) $x[n] = \sin(3n)$ (ii) $x[n] = \cos\left(0.3\pi n + \frac{\pi}{4}\right)$ (iii) $x[n] = \sin\left(\frac{7\pi}{37} n\right)$	L2	6 Marks
	c	A signal $x(t) = (t+1)[u(t) - u(t-1)]$, is applied as input to a differentiator. Obtain the output signal y(t) and sketch the same.	L3	6 Marks
		Module-2		
Q. 03	a	Following signals represent input and impulse response of a continuous-time Linear and Time-Invariant (LTI): $x(t) = u(t) - u(t-3)$ $h(t) = e^{-2t}[u(t+1) - u(t-1)]$ Obtain the output for the applied input.	L3	8 Marks

	b	Determine whether the following systems represented by input-output relations are Time-Invariant and Invertible: (i) $y[t] = x\left(\frac{t}{2}\right)$ (ii) $y(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$ (iii) $y[n] = x[n] + x[n-1]$ (iv) $y[n] = x[n]u[n]$	L2	8 Marks
	c	Perform Convolution operation on the following signals: $x[n] = \delta[n+1] - \delta[n-1] + \delta[n-3]$ $h[n] = \delta[n] - \delta[n-2]$ Sketch the resulting signal.	L3	4 Marks
OR				
Q.04	a	Determine whether the following system represented by input-output relation is stable and causal: $y[n] = x[n+1] + x[n] + x[n-1]$.	L3	4 Marks
	b	Given $x[n] = \alpha^n u[n]$ and $h[n] = \beta^n u[n-1]$, obtain y[n] =x[n] *h[n].	L3	8 Marks
	c	Show that distributive and associative laws hold good with respect to convolution operator in continuous-time domain.	L2	8 Marks
Module-3				
Q. 05	a	Show that the step response of an LTI system is running integral of impulse response.	L2	4 Marks
	b	Determine whether the following systems represented by impulse response are causal and stable: (i) $h[n] = 5\,\delta[n]$ (ii) $h[n] = \left(\frac{1}{4}\right)^{\lvert n\rvert}$ (iii) $h[n] = \left(\frac{1}{2}\right)^{-n} u[-n]$	L2	6 Marks
	c	Find the complex Fourier coefficients X(k) for x(t) shown in Fig. Q5(c). Also sketch magnitude and phase spectra.  Fig. Q5(c)	L3	10 Marks
OR				
Q. 06	a	Find complex Fourier series coefficients X(k) of the signal $x(t) = \lvert\sin \pi t\rvert$	L3	6 Marks
	b	Using the derivative property of continuous-time Fourier series, obtain X(k) of the signal x(t) shown in Fig. Q6(b).  Fig.Q6(b)	L3	8 Marks
	c	Obtain the step response for the following systems represented by impulse response: (i) $h[n] = \delta[n+3] - 2\,\delta[n] + 3\,\delta[n-2]$ (ii) $h[n] = u[n+2] - 2u[n] + u[n-3]$	L2	6 Marks

Module-4				
Q. 07	a	Given $x(t) = \begin{cases} A, -T < t < T \\ 0, \text{ Otherwise} \end{cases}$ Obtain the Fourier transform of x(t). Also, sketch the magnitude and phase spectra.	L3	6 Marks
	b	Derive the Parseval relationship applicable to DTFT and mention its significance.	L2	6 Marks
	c	Given the Fourier transform of x(t), $X(j\omega) = \frac{j\omega}{-\omega^2+7\,j\omega+6}$, find the Fourier transform of the following signals: (i) $x(4t-8)$ (ii) $\int_{-\infty}^{t} x(\tau)d\tau$ (iii) $e^{-j100t}x(t)$	L3	8 Marks
OR				
Q. 08	a	Show that DTFT is a periodic function of fundamental period 2π rad.	L2	4 Marks
	b	State and prove the following properties with respect to continuous-time Fourier Transform: (i) Frequency shifting (ii) Modulation	L2	8 Marks
	c	Find the DTFT of the following sequences: (i) $x[n] = n\,0.5^n u[n]$ (ii) $x[n] = \left(\frac{1}{4}\right)^n u[n-4]$ (ii) (iii) $x[n] = \left(\frac{1}{4}\right)^n u[n] * \left(\frac{1}{3}\right)^n u[n]$	L3	8 Marks
Module-5				
Q. 09	a	Find the Z-transform of the signal $x[n] = (\,n(-0.5)^n u[n]) * 4^n u[-n]$.	L3	8 Marks
	b	Using long division method, find the inverse Z-transform of $X(z) = \frac{2+z^{-1}}{1-0.5z^{-1}}$ ROC: $\|z\| > 0.5$	L3	4 Marks
	c	An LTI system has impulse response $h[n] = 0.5^n u[n]$. Determine the input to the system if the output is given by $y[n] = 0.5^n u[n] + (-0.5)^n u[n]$	L3	8 Marks
OR				
Q. 10	a	Determine the transfer function and a difference equation representation of an LTI system described by the impulse response: $h[n] = \left(\frac{1}{3}\right)^n u[n] + \left(\frac{1}{2}\right)^{n-2} u[n-1]$	L3	8 Marks
	b	A stable and causal LTI system is described by the difference equation: $y[n] + 0.25y[n-1] - 0.125\,y[n-2] = -2x[n] + 1.25\,x[n-1]$. Find the system impulse response.	L3	8 Marks
	c	Find the Z-transform of $x[n] = 0.5^n u[n] + 2^n u[-n-1]$.	L3	4 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.