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An Autonomous Institution Affiliated to Visvesvaraya Technological University (VTU) Belagavi

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24EC42

Fourth Semester B.E. Degree Examination, May 2026
BASIC SIGNAL PROCESSING

TIME:3 hrs. Max.Marks:100

Note: 1. Answer **any FIVE** full questions, choosing **ONE** question from **each MODULE.**
2. M: Marks, L: Bloom's level,C: Course outcomes.
3. Assume missing data suitably

		Module-1	M	L	C
Q.1	a	Explain sampling theorem.	6	L2	CO1
	b	Sketch the following signals. $(i)\ x(n) = \left(\frac{1}{3}\right)^n u(n+1)$ $(ii)\ x(n) = \lvert n-1 \rvert \quad ; -4 \le n \le 3$ $= 0 \quad ; otherwise.$	8	L3	CO1
	c	Explain (i) unit step sequence (ii) unit impulse sequence.	6	L2	CO1
		OR			
Q.2	a	Determine whether the following signals are periodic or not. If periodic, find its fundamental period. $(i)\ x(n) = (-1)^n (ii)\ x(n) = 5sin\left(\frac{7\pi}{12}n\right) + 8cos\left(\frac{14\pi}{8}n\right)$	6	L3	CO1
	b	Decompose the signal $x(n) = 3u(n-2)$ into even and odd parts.	8	L3	CO1
	c	Check whether the following signals are energy or power signals. $(i)\ x(n) = A\delta(n) \quad (ii)\ x(n) = 3(-1)^n u(n)$	6	L3	CO1
		Module–2			
Q.3	a	Explain the various properties of systems with examples.	6	L2	CO2
	b	Distinguish between the following. (i) Time variant and Time invariant systems (ii) Causal and Non-causal system	6	L2	CO2
	c	For the following discrete-time systems, determine whether the system is (i) Linear (ii) Time variant (iii) Memoryless (iv) Causal and (v) Stable. $(i)\ y(n) = nx(n) (ii)\ y(n) = x^2(n)$	8	L3	CO2
		OR			
Q.4	a	What do you mean by invertible and non-invertible system.	6	L2	CO2
	b	Distinguish between stable and unstable system.	6	L2	CO2
	c	Find the overall response of a system whose output signal is given by, $y(n) = \frac{1}{3}[x(n) + x(n-1) + x(n-2)]$ Also draw the block diagram representation.	8	L3	CO2
		Module–3			
Q.5	a	Explain the commutative and distributive properties of convolution.	6	L2	CO3

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	b	Derive the relationship between input, output and impulse response in a discrete-time LTI system.	6	L3	CO3
	c	Find $y(n) = x(n) * h(n)$ where $x(n) = \{1,2,3,4\}$ & $h(n) = \{1,1,1\}$.	8	L3	CO3
		OR			
Q.6	a	The impulse responses of discrete-time systems are given below. Determine whether each system is (i) memoryless (ii) causal and (iii) stable. $(i)\ h(n) = \left(\frac{1}{2}\right)^n u(n) (ii)\ h(n) = e^{2n}u(n-1).$	6	L3	CO3
	b	Evaluate the unit step response for the LTI system given by the following impulse responses $(i)\ h(n) = \left(\frac{1}{2}\right)^n u(n)$ and $(ii)\ h(n) = u(n)$.	6	L3	CO3
	c	Find the natural response for the system given by, $y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with $y(-1) = 0$ and $y(-2) = 1$.	8	L3	CO3
		Module–4			
Q.7	a	Explain DTFS.	6	L2	CO4
	b	State and prove the following properties of DTFT. (i) Frequency shift (ii) Parseval's theorem.	6	L2	CO4
	c	Find the DTFT of the signal $x(n) = \alpha^n u(n)\ ;\ \lvert\alpha\rvert < 1$. Draw the magnitude spectrum.	8	L3	CO4
		OR			
Q.8	a	Determine the DTFS of the signal $x(n) = cos\left(\frac{\pi}{3}n\right)$ and draw the spectrum.	6	L3	CO4
	b	Using the appropriate properties, find the DTFT of the signal given by, $x(n) = \left(\frac{1}{2}\right)^n u(n-2).$	8	L3	CO4
	c	Obtain the frequency response and impulse response of the system described by the difference equation, $y(n) + \frac{1}{2}y(n-1) = x(n) - 2x(n-1).$	6	L3	CO4
		Module–5			
Q.9	a	Write any 4 properties of region of convergence.	6	L2	CO5
	b	State and prove the following properties of Z-transform. (i) Time reversal (ii) Scaling in Z-domain	6	L2	CO5
	c	Find the Z-transform and ROC of the following signals. $(i)\alpha^n u(n)$ $(ii)\alpha^n cos(\Omega_o n)u(n)$	8	L3	CO5
		OR			
Q.10	a	State and prove initial value theorem.	6	L2	CO5
	b	A causal system has input $x(n)$ and output $y(n)$. Find the impulse response of the system if, $x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$ $y(n) = \delta(n) - \frac{3}{4}\delta(n-1).$	8	L3	CO5
	c	Determine the unilateral Z-transform of the signal, $x(n) = \alpha^n u(n+1)$	6	L3	CO5

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