USN:

21ECE142

B.N.M. Institute of Technology

An Autonomous Institution under VTU

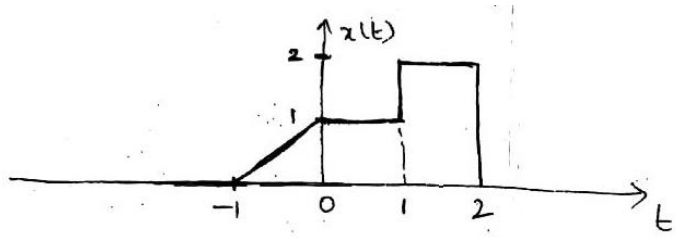
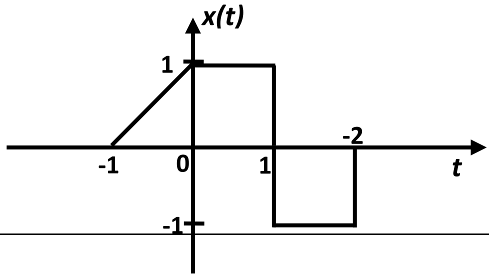
Fourth Semester B.E. Degree Examination

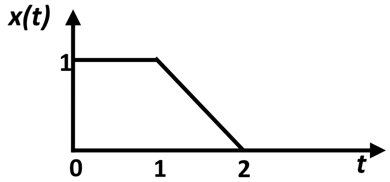
Model Question Paper

Digital Signal Processing

Duration: 3 Hours **Max. Marks:** 100

Note: 1. Answer any one full question from Module 1,2,3,4,5 (5Q x 20M = 100 Marks)

Module 1					
Q. No	**Questions**	**Marks**	**CO**	**PO**	**Cognitive Level**
1 (a)	Determine whether the discrete time signal is periodic or not. If periodic, find the fundamental period. x(t) = cos(2t) + sin (2πt).	4	1	1	Apply
1 (b)	Sketch and label each of the following signals, given x(t) as shown in Figure 1.  Figure 1 i. x(t) u(1-t) ii. x(t)[u(t)-u(t-1)] iii. x(t) δ(t-3/2) iv. x(t+1) x(-t)	8	1	1	Apply
1 (c)	Find whether the following signals are energy or power signals. Find the energy/power in each case. i. x(n) = u(n) ii. x(n) = (j)n + (-j)n iii. x(t) = A Cos(w_0 t), T_0=2 /w_0	8	1	1	Apply
OR					
2 (a)	Determine the even and odd part of the signal x(t) shown in Figure 2 Figure 2 	4	1	1	Apply

2 (b)	Sketch the following, given x(t) as shown in Figure 3. *(i)* $x(\frac{t}{2}-2)$ *(ii)* $x(2t+3)$ *iii.* $x(3-t)$ *iv.* $2x(t+1)\delta(t)$ Figure 3 	8	1	1	Apply
2 (c)	Determine whether the following signals are energy signal or power signal and calculate its energy or power $(i)\ x[n]=8(0.5)^n u(n)$ $(ii) x(t) = e^{(1+2t)}u(1-t)$	8	1	1	
	Module 2				
3 (a)	Determine whether the following system is stable, memory less, causal, linear and time invariant? $y(t)=x(2-t)$	10	2	1,2	Apply
3 (b)	Perform Convolution operation on the following signals & sketch the resulting signal. x[n] $=2^n\, u[-n]$, h[n] $=u[n]$.	10	2	1,2	Apply
	OR				
4 (a)	Determine whether the following system is stable, memory less, causal, linear and time invariant? $y(n)=sin[x(n)]$	10	2	1,2	Apply
4 (b)	Perform convolution operation on the following signals: Sketch the resulting signal. $x_1(t) = e^{-t}\, u(t)$ and $x_2(t) = u(t+3)$	10	2	1,2	Apply
	Module 3				
5 (a)	Find the z transform of $\mathbf{x(n)} = 3^n u(-n-1)-(0.2^n)u(n)$	6	3	1,2	Apply
5 (b)	Find the DTFT of the signal $\mathbf{x(n)} = (0.5)^{n+2}u(n)$	6	3	1,2	Apply
5 (c)	Calculate circular convolution of two sequences using DFT and IDFT approach. **x(n)={2,1,2,1} and h(n)={1,2,3,4},**	8	3	1,2	Apply
	OR				
6 (a)	Find the z transform of $\mathbf{x(n)} = 0.5^n u(n) + 2^n u(-n-1)$	6	3	1,2	Apply
6 (b)	Find the DTFT of the signal $\mathbf{x(n)} = (0.5)^n u(n-4)$	6	3	1,2	Apply
6 (c)	Find the 8-point DFT of the sequence **x(n) = {1,1,1,1,1}.**	8	3	1,2	Apply
	Module 4				
7 (a)	Design a digital high pass Butterworth filter to meet the following specifications. i) Passband ripple: ≤ 15dB ii) Passband edge: 150Hz iii) Stopband attenuation: ≥ 1dB iv) Stopband edge: 100Hz v) Sampling frequency: 1kHz. Use Bilinear Transformation.	10	4	1,2,3	Apply

7 (b)	Derive an expression for order and cutoff frequency of analog Butterworth lowpass filter.	6	4	1,2,3	Understand
7 (c)	Obtain the direct form I realization of a digital IIR filter described by the system function: $\mathbf{H(z)} = \frac{8z^3-4z^2+11z-2}{\left(z-\frac{1}{4}\right)\left(z^2-z+\frac{1}{2}\right)}$	4	4	1,2,3	Apply
OR					
8 (a)	Design a digital Butterworth lowpass filter which is required to meet the following specifications: (i) -3.01 dB cutoff frequency of 0.5π rad. (ii) Stopband attenuation of at least 15dB at 0.75π rad. Use bilinear transformation. Find the system function H(z) and the difference equation realization.	10	4	1,2,3	Apply
8 (b)	Find the 5[th] order normalized Butterworth polynomial.	6	4	1,2,3	Understand
8 (c)	Obtain the direct form-I realization for the following system: $\mathbf{y(n)} - \frac{1}{4}\mathbf{y(n-1)} + \frac{1}{8}y(\mathbf{n-2}) = \mathbf{x(n)} + \frac{1}{2}\mathbf{x(n-2)}$.	4	4	1,2,3	Apply
Module 5					
9 (a)	Write the equation and frequency response of Hanning and Hamming windows used in the FIR filter design.	4	5	1,2,3	Understand
9 (b)	Design a low pass filter with the following desired frequency response: $$\mathbf{H(\omega)} = \begin{cases} e^{-j2\omega}, & \lvert\omega\rvert < \frac{\pi}{4} \\ 0, & \frac{\pi}{4} < \lvert\omega\rvert < \pi \end{cases}$$ Determine the filter coefficients $h_d(n)$ and h(n) if w(n) is a rectangular window defined as $$w_R(\mathbf{n}) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$	8	5	1,2,3	Apply
9 (c)	Show that FIR filters provide Linear phase response when the impulse response of the filter is symmetric for order being even.	8	5	1,2,3	Understand
OR					
10 (a)	Write the equation and frequency response of Bartlett and Blackmann windows used in the FIR filter design.	4	5	1,2,3	Understand
10 (b)	Design the symmetric FIR, lowpass filter whose desired frequency response is given as $$\mathbf{H(\omega)} = \begin{cases} e^{-j\alpha\omega}, & \lvert\omega\rvert < \omega_c \\ 0, & \text{otherwise} \end{cases}$$ The length of the filter should be 7 and $\omega_c = 1$ radian/sample use rectangular window.	8	5	1,2,3	Apply

10 (c)	Show that FIR filters provide Linear phase response when the impulse response of the filter is symmetric for the order being odd.	8	5	1,2,3	Understand

Prepared by	**Approved by HOD**	**Approved by Principal**
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