B.TECH/ ECE/6TH SEM/ ECEN 3202/2018
DIGITAL SIGNAL PROCESSING & APPLICATIONS
(ECEN 3202)

x(n)={2,4,5,7,0,1}?
↑

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The digital system in $y[n] = e^{x(n)}$ is
(a) linear and time variant (b) non linear and time invariant
(c) non linear and time variant (d) linear and time invariant.

(ii) The z-transform of δ(n-m) is
(a) z^{-n} (b) 1/(z-n) (c) z^{-m} (d) 1/(z-m).

(iii) If x[n]= {1,0,0,1}, The DFT value of X(0) is
(a) 1+j (b) 1-j (c) 0 (d) 2.

(iv) The convolution of u(n) and u(n-4) at n=5 is
(a) 2 (b) 5 (c) 1 (d) 0.

(v) Pole of Chebyshev filter lies on a
(a) rectangle (b) circle (c) parabola (d) ellipse.

(vi) An FIR filter is
(a) unstable and linear phase (b) stable and linear phase
(c) stable and non linear phase (d) unstable and non linear phase.

(vii) An LTI system is said to be causal if and only if
(a) impulse response is non-zero for positive values of n
(b) impulse response is zero for positive values of n
(c) impulse response is non-zero for negative values of n
(d) impulse response is zero for negative values of n.

(viii) What is the z-transform of the finite duration signal

(a) $2 + 4z + 5z^2 + 7z^3 + z^4$ (b) $2 + 4z + 5z^2 + 7z^3 + z^5$
(c) $2 + 4z^{-1} + 5z^{-2} + 7z^{-3} + z^{-5}$ (d) $2z^2 + 4z + 5 + 7z^{-1} + z^{-3}$.

(ix) If x(n) and X(k) are N-point DFT pair, then X(k+N)=?
(a) X(-k) (b) -X(k) (c) X(k) (d) None of the mentioned.

(x) Which of the following rule is used in the bilinear transformation?
(a) Simpson's rule (b) Backward difference
(c) Forward difference (d) Trapezoidal rule.

Group – B

2. (a) A system has unit sample response h(n) given by h(n) = -1/4 δ(n+1) + 1/2 δ(n) -1/4 δ(n-1). Is the system BIBO stable? Is the filter causal? Justify your answer.

(b) Find the step response of the system described by difference equation y(n) – 1/6 y(n-1) – 1/6 y(n-2) = x(n)

(c) Determine the convolution of the following pair of signals
$x_1(n) = u(n-2)$ $x_2(n) = \delta(n) + (1/2)^n u(n)$

3+ 5 + 4 = 12

3. An analog signal $x_a(t)=4\sin(40\pi t)+5\cos(80\pi t)$ is sampled with sampling rate of 400 samples per second to get the discrete time signal x(n).

(a) What is the Nyquist sampling rate for $x_a(t)$?
(b) Determine the folding frequency.
(c) What are the frequencies, in radian, in the resulting discrete time signal x(n) ?
(d) If x(n) is passed through an ideal D/A converter, what is the reconstructed signal $y_a(t)$?

2 + 1 +4 + 5= 12

Group – C

4.(a) What is FFT? Explain Radix 2 FFT algorithm?

(b) Derive the expression of DIF algorithm for 8 point DFT.

(c) Determine 8 point DFT of x(n)={1,1,2,3} using DIF butterfly structure.

2 + 3 + 7 = 12

5.(a) Determine the output response y(n) if h(n) ={1,2,1} and x(n) = {2,1,3,4} by
i) circular convolution method
ii) circular convolution using zero padding to obtain linear convolution.

(b) Find the DFT of sequence x(n) = {1,2,3,4,4,3,2,1} using DIT-FFT algorithm.

6 + 6 =12

Group – D

6. (a) Write down the comparison between Butterworth filter and Chebyshev filter.

(b) Derive the expression for order of analog low pass Butterworth filter.

(c) For the given specifications design an analog Butterworth filter.
$0.9 \leq |H(j\Omega)| \leq 1 \quad 0 \leq \Omega \leq 0.2\pi$
$|H(j\Omega)| \leq 0.2 \quad 0.4\pi \leq \Omega \leq \pi$

3 + 3 + 6=12

7.(a) State some advantages of digital filters. State some disadvantages of impulse invariance technique to design digital filters.

(b) Design a digital filter with the following specifications:
α_p=4; α_s=30; f_p=400 Hz and f_s=600Hz. Where α_p and α_s are pass band and stop band attenuations at the cut off frequencies at f_p and f_s respectively. Use Bilinear Transformation Technique.

4 + 8 = 12

Group – E

8.(a) Realize the system given by difference equation
y(n)= – 0.1y(n-1) +0.72y(n-2) + 0.7x(n) – 0.252x(n-1) in DirectformII.

(b) Realize the system function
$H(Z)=1/2 + 1/3(Z^{-1}) + Z^{-2} + 1/4(Z^{-3}) + Z^{-4} + 1/3 (Z^{-5}) + 1/2 (Z^{-6})$. Use cascade form.

6 + 6 = 12

9. Write short notes on any two of following.
(i) Windowing Technique.
(ii) Bilinear Transformation.
(iii) Multirate Signal Processing
(iv) Architecture of TMS 320C5416

6 * 2 = 12