

Code No: 127CK/117CK

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**B. Tech IV Year I Semester Examinations, March - 2021****DIGITAL SIGNAL PROCESSING****(R15 – Electrical and Electronics Engineering;****R13 - Electrical and Electronics Engineering)****Time: 3 Hours****Max. Marks: 75**

Answer any Five Questions
All Questions Carry Equal Marks

- 1.a) Determine the response of the causal system $y(n) - y(n-1) = x(n) + x(n-1)$ to inputs $x(n) = u(n)$ and $x(n) = 2^{-n}u(n)$. Test its stability.
- b) With necessary equations explain the structure of FIR filters using Direct and Canonic forms. [7+8]
- 2.a) State and prove the properties of Discrete Fourier Series.
- b) Find $X(K)$ using DIF FFT algorithm for the sequence $x(n) = \{1, 2, 3, 4, 5, 6, 7, 0\}$ [7+8]
- 3.a) Determine the system function $H(Z)$ of the lowest order Chebyshev digital filter that meets the following specifications:
 i) 4 dB ripple in the passband $0 \leq |\omega| \leq 0.6\pi$
 ii) At least 50 dB attenuation in the stopband $0.65\pi \leq |\omega| \leq \pi$.
 Use the bilinear transformation.
- b) Discuss in detail about Spectral Transformations. [9+6]
- 4.a) Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n) = \pm h(M-1-n)$, $n = 0, 1, \dots, M-1$. Also discuss symmetric and anti symmetric cases of FIR filter.
- b) Design a FIR filter whose frequency response
 $H(e^{j\omega}) = 1$ for $\pi/4 \leq \omega \leq 3\pi/4$ and 0 for $|\omega| \leq \pi/4$.
 Calculate the value of $h(n)$ for $N=11$ and hence find $H(z)$. [7+8]
- 5.a) What is the difference between single-rate and multi-rate systems? Explain with examples.
- b) What do you mean by fractional sampling rate conversion? Explain with an example of converting 48 kHz signal to 44.1 kHz signal using multi-stage fractional sampling rate converter. [7+8]
- 6.a) Obtain direct form I, direct form II and cascade realizations of system described by the equation, $y[n] = y[n-1] - (1/2)y[n-2] + x[n] - x[n-1] + x[n-2]$.
- b) Distinguish between FIR and IIR filters. [9+6]
- 7.a) Design an ideal Hilbert transformer having frequency response
 $H(e^{j\omega}) = j$ for $-\pi \leq \omega \leq 0$ and $-j$ for $0 \leq \omega \leq \pi$
 for $N=11$ using rectangular window.
- b) Why Kaiser window is used most for design of FIR filters? [9+6]
- 8.a) Derive the relation between impulse response and frequency response of Discrete Time System.
- b) Compute the FFT for the sequence $x(n) = n^3 + 1$ using DIF algorithm. [7+8]

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