Exam Date & Time: 14-May-2022 (10:00 AM - 01:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY 2022

DIGITAL SIGNAL PROCESSING [ICE 3251]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) If $x[n] \rightarrow X(z)$ is minimum phase and the convolution sum $y[n] = x[n] * x[-n]$ is known, suggest a scheme to determine x[n]. Hence for the given y[n],

A) $y[n] = \frac{9}{8}\left(\frac{1}{3}\right)^n u[n] + \frac{9}{8}(3)^n u[-n-1]$, determine x[n]. (5)

B) The system has its zeros at $\pm j$ and poles at $-\frac{1}{2} \pm \frac{j1}{2}$. H(1)=0.8. Determine the difference equation describing the system. (3)

C) The transfer function of a system is given by $H(Z) = 1 - z^{-1}$. Find the response of the system for any input x[n]. (2)

2) In a LTI system, given the input is x[n] ={1, 2, 1} and the impulse response of the system is h[n] = {1, 3}. Determine y[n], the response of the LTI system using radix-2 DIT FFT algorithm. (5)

A)

B) State and explain the Time reversal, Up-Sampling, and Right-Shifting properties of Z-transform. (3)

C) Mention any two differences and similarities between DITFFT and DIFFFT algorithms. (2)

3) Compute the 4-point DFT of the sequence x[n]={1,0,1,0}. Determine y[n] if Y(k)=X((k-2)). (4)

A)

B) Calculate the percentage saving in calculations(complex additions and multiplications) in a 512-point radix-2 FFT, when compared to direct DFT. (3)

C) Design a linear phase lowpass FIR filter using rectangular window, given $\omega_c = \pi/4$ radians/sample and length of the filter=5. Determine the filter coefficients h[n]. (3)

4) Design a Butterworth digital IIR low-pass filter using bilinear transformation by taking T=0.5 second, to satisfy the following specification

A) $0.707 \leq |H(e^{j\omega}| \leq 1; for\ 0 \leq \omega \leq 0.45\pi$ (5)

$|H(e^{j\omega}| \leq 0.2; for\ 0.65\pi \leq \omega \leq \pi$

B) Determine the poles of lowpass Butterworth filter for N = 3. Sketch the location of poles on s-plane and hence determine the normalized transfer function of lowpass filter. (3)

C) Draw the direct form-I structure of second-order IIR system with equal number of poles and zeros. (2)

5) Mention the names of any four TMS320 series of digital signal processors released by Texas instruments. Draw and explain the internal architecture of TMS320C5x processor. (5)

A)

B) Explain the role of digital signal processing in DTMF application. (3)

C) Highlight the features of frequency sampling method that differentiate it from window method. (2)

-----End-----