

SIXTH SEMESTER B.TECH (INSTRUMENTATION AND CONTROL ENGG) END SEMESTER EXAMINATION JANUARY 2021

DIGITAL SIGNAL PROCESSING [ICE 3202]

06-01-2021

TIME: 3 HOURS

MAX. MARKS: 50

Instructions to candidates : Answer ALL questions and missing data may be suitably assumed.

- 1A. List any four advantages of digital signal processing over analog signal processing.
- 1B. Given the discrete time signal $x[n] = 0.3^n u[-n-1] + 0.1^n u[n]$, determine X(Z), and explain the significance of the obtained ROC.
- 1C. Determine the step response of LTI system whose impulse response h[n] is given by,

$$h[n] = a^{-n}u[-n]; 0 < a < 1$$
(2+3+5)

- 2A. Given that, $X(Z) = 2(1 + Z^{-1})(1 Z^{-1})^2$, find the inverse Z-transform.
- 2B. State and prove the circular time shift and convolution properties of Z transform.
- 2C. Compute the circular convolution of the sequences x[n] = [1, 2, 3] and h[n] = [1, 2, 3] using DFT.

(2+3+5)

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- 3A. List any two benefits of FFT algorithms.
- 3B. Obtain the DF-I and DF-II structures for the given system: y[n] = -0.5y[n-1] + 0.3y[n-2] + 0.5x[n] + 4.2x[n-1] + 0.5x[n-2]
- 3C. In LTI system, given the input x[n]=[1,2,3] and the impulse response h[n]= [-1,-1], determine the response of the system using radix 2 DITFFT algorithm.
- 4A. Mention any two important features of IIR filters.
- 4B. What is impulse invariance transformation method of digital filter design? Justify why is it not considered to be one to one mapping.
- 4C. Design a Butterworth digital IIR lowpass filter using bilinear transformation by taking T=0.1second, to satisfy the following specifications:
 - $\begin{array}{l} 0.6 \leq \left| H(e^{j\omega}) \right| \leq 1.0 \hspace{0.2cm} ; for \hspace{0.1cm} 0 \leq \omega \leq 0.35\pi \\ \left| H(e^{j\omega}) \right| \leq 0.1 \hspace{0.2cm} ; for \hspace{0.1cm} 0.7\pi \leq \omega \leq \pi \end{array}$

(2+3+5)

- 5A. What do you mean by energy spectrum of a discrete time signal? Draw a relation between energy spectrum and autocorrelation sequence.
- 5B. Explain how frequency resolution is obtained in Bartlett estimation. Calculate the frequency resolution for the Bartlett estimate when the quality factor is 8 and 200 samples of signal are available.
- 5C. What do you mean by linear phase filters? Design a linear phase FIR bandpass filter to pass frequencies in the range 0.35π to 0.48π rad/sample using Hanning window sequence. Take number of samples, N=7.

(2+3+5)
