Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER DEGREE EXAMINATION, APRIL/MAY - 2019

SUBJECT: DIGITAL SIGNAL PROCESSING [ICE 3202]

TIME: 3 HOURS MAX. MARKS: 50

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

1A If $Z\left(x(n)\right)=X(z)$, then prove that:

i. $x(\infty)=Lt_{z\to 1}\left(1-z^{-1}\right)X(z)$

ii. $Z\left(x(n-m)\right)=z^{-m}X(z)+\sum_{i=1}^{m}x(-i)z^{-(m-i)}\ ;\ n\in(0,\infty)$

1B Find the inverse Z-transform for

$$X(z)=\frac{2}{z^2-z+0.5}+\frac{2z-4}{(z-1)(z+2)^2}$$

1C The Z-transform of

$x(n)=-n^2a^nu(-n-1)$ is _____ .

(4+4+2)

2A Compute the DFT of $x(n)=\{1,2,1,2,1,3,1,3\}$.

2B Determine the response of LTI system by radix 2 DIF-FFT when the input sequence $x(n)=\{1,2,3\}$ and the impulse response $h(n)=\{-1,-1\}$.

2C Compute circular convolution of the following sequences $x_1(n)=\{1,2\}$ and $x_2(n)=\{2,1\}$.

(4+4+2)

3A Sketch the frequency responses of an analog chebyshev IIR low pass filters for change in 'types' and 'order'.

3B Design a digital Butterworth IIR low pass filter for the given un-normalized analog transfer function using bilinear transformation with T = 0.1 sec. Also, draw the direct form II structure of it.

$$H(S)=\frac{154.85}{s^2+17.5s+154.85}$$

3C Obtain the normalized analog transfer function for the given Butterworth digital IIR low pass filter specification using impulse invariant transformation by taking T = 1 sec.

$$0.707\le|H(e^{jw})|\le 1.0\ ;\ \text{for } 0\le w\le 0.3\,\pi$$

$$|H(e^{jw})|\le 0.2\ ;\ \text{for } 0.75\,\pi\le w\le\pi$$

(2+3+5)

4A Design a linear phase FIR high pass filter using hamming window with $w_c = 0.8\pi$ rad/sample and N = 7.

4B Bring out the relation between location of analog and digital IIR filter poles in many-to-one mapping technique.

4C Derive the expression for linear phase characteristics of FIR filter.

(5+3+2)

5A Design a FIR low pass digital filter with cut-off frequency of 1kHz and sampling frequency of 4kHz with 11 samples using Fourier series method.

5B Explain Periodogram and Bartlet method of PSD estimation with relevant equations.

5C Prove that Periodogram is the Fourier transform of the auto correlation sequence of a finite power signal x(n).

(5+3+2)

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