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PES University, Bengaluru

(Established under Karnataka Act No. 16 of 2013)

UE14EE353

MAY 2017: END SEMESTER ASSESSMENT (ESA) B.TECH. VI SEMESTER

UE14EE353- DIGITAL SIGNAL PROCESSING

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1.	a)	The input sequence x (n) of length 100 is convolved with a unit sample sequence of length 64 using 128-point DFT. Indicate I) number of zeros appended if convolution preferred is circular. II) Length of linear convolution and is there an aliasing? III) for what index values *n* circular and linear convolution results are same?	06
	b)	Find the inverse DFT of $Y(k) = \lvert X(k)\rvert^2$ where $X(k)$ is the *6* point DFT of $x(n) = u(n) - u(n-4)$.	06
	c)	Use known standard DFT's to compute 10 point DFT of $x(n) = \delta(n) + \frac{1}{5} + \cos\left(\frac{3\pi n}{5}\right)$. $0 \le n \le 9$. Also mention any property used.	08
2.	a)	Give 2 – point DFT computational equation if time and frequency variables are independently decimated and show pictorial representation highlighting multiplication and additions involved.	06
	b)	A long input data sequence of length *2000* is to be filtered using impulse sequence of length *250*. Suppose a *256* point DFT – IDFT is employed, compute the number of DFT & IDFT necessary by overlap save and overlap add methods.	06
	c)	Apply radix – 2 DIT – FFT technique to compute 8 – point DFT of 8 – point *circularly even* real sequence given the first five samples as x (n) = *{1, 0 1, 0, 0}*.	08
3.	a)	In each of the following filter functions identify the *type, order* of filter and associated *frequencies* and *magnitude at dc frequency*, if applicable. i) $H(s) = \frac{s^2 + 100^2}{(s+100)^2}$ ii) $H(s) = \frac{s}{s+60}$	06
	b)	Use examples to prove that angle of separation between poles is a function of filter order in analog Butterworth filter.	06
	c)	Design a low pass analog filter to satisfy the following requirements: ➢ Monotonic response in pass band and stop band ➢ –3 dB attenuation in pass band at an edge frequency of 100 rad/s ➢ –20 dB stop band attenuation at an edge frequency of 400 rad/s	08
4.	a)	Realize the filter function given in adjacent box in direct form 2 & cascaded form with least number of delays. $H(z) = \frac{(1+z^{-1})^2}{(1+\frac{1}{2}z^{-1})(1+\frac{5}{4}z^{-1}+\frac{1}{4}z^{-2})}$	06

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	b)	Causal digital filter function obtained by Bilinear transformation with T = 2 s is $\frac{5z^2+4z-1}{8z^2+4z}$. Determine the parent analog transfer function.	06
	c)	Design a first order digital highpass Butterworth filter to satisfy the requirement of – 3 dB ripple in pass band at a cutoff frequency of 3000Hz. Assume 8000Hz as the sampling frequency. Use Bilinear transformation.	08
5.	a)	Suggest a suitable window and calculate window length, assuming a transition frequency of 500 Hz & sampling frequency of 5000 Hz, given: i. Attenuation of near *0 dB* in pass band & *70* dB in stop band ii. Attenuation of near *1 dB* in pass band & *25* dB in stop band iii. Attenuation of near 0.02 *dB* in pass band & *55* dB in stop band	06
	b)	Find order N & control parameter β of Kaiser window given the frequency specifications: ▪ Cutoff frequency 2200π rad/s ▪ Transition width 900π rad/s ▪ Sampling frequency 12000Hz ▪ Pass band ripple 0.015dB ▪ Maximum stop band attenuation 50dB.	06
	c)	Design a lowpass linear phase FIR filter using Hamming window to satisfy following requirements: Passband edge frequency: 1.3 kHz Stopband edge frequency: 4.5 kHz Sampling frequency: 8 kHz.	08

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