Ref No: Ex/EE/5/T/414/2018(S)

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) FOURTH YEAR FIRST SEMESTER SUPPLEMENTARY EXAM 2018

SUBJECT: - DIGITAL SIGNAL PROCESSING

Full Marks 100

Time: Three hours (50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	*Answer **any three** questions. **TWO** marks are reserved for neat and well organized answers.*	
1.a)	How can you compute 4-point FFT of a discrete sequence using Radix-2 decimation-in-frequency in-place FFT algorithm? Draw the corresponding signal flow graph.	12
(b)	Describe and prove the symmetry property of DFT.	04
2. a)	A 7-tap causal linear-phase FIR brick-wall type low-pass filter has been designed with unity pass band gain and a cut off frequency of 200 Hz. The sampling frequency has been chosen as 800 Hz. The design employed Raised Cosine window for smoothing filter coefficients. Determine the filter coefficients. Also draw the schematic realization of the filter.	10
b)	What is Gibbs phenomenon? How can its adverse effect be reduced?	06
3.a)	How can FIR digital filters be employed for offline analysis of two-dimensional data? How can two-dimensional convolution summation be utilized in this regard?	06
b)	Derive the expression of frequency response for a causal FIR filter having a delayed and truncated real and symmetric impulse sequence and, hence, show that the group delay of this filter is a constant quantity.	10
4. a)	In image processing, what is the importance of a two-dimensional sampling function and a two-dimensional sampled sequence? How are FIR high-pass image filters designed to sharpen images?	07+05
4. b)	"In FFT computations, computation of each butterfly involves two real additions and two real multiplications." – Justify or correct the statement citing suitable reasons.	04

[Turn over

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No. of Questions	PART I	Marks
5.	Write short notes on ***any two*** of the following: a) Direct realization of linear phase FIR digital filters. b) Fourier series for a periodic discrete sequence. c) Frequency response of a non-causal raised cosine window.	08+08

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B.E.E. (EVENING) 4TH YEAR 1ST SEMESTER SUPPLEMENTARY EXAMINATION, 2018

SUBJECT: - DIGITAL SIGNAL PROCESSING

Time: Three hours | **Full Marks 100 (50 marks for each part)**

Use a separate Answer-Script for each part

No. of Questions	PART-II	Marks
	Answer any five (5X10=50)	
1.	Explain the importance of frequency pre-warping in designing of digital filters using bilinear transformation.	10
2.	Show that, ROC of Z-transfer function of an infinite duration **causal signal** is entire exterior of a circle centred at origin & that of infinite duration **anti-causal** sequence is entire interior of a circle centred at origin in z-plane.	10
3. a)	Explain in details how the entire left half of s-plane maps on to z-plane.	5
b)	Derive the transfer function and block diagram (structure) representation of a **discrete time differentiator**.	5
4.	If $X(z)=\dfrac{z^3+z^2}{z^2-4z+3}$, Find $Z^{-1}\left[X(z)\right]$ when a) ROC of X(z) is $3<\lvert z\rvert<\infty$ b) ROC of X(z) is $1<\lvert z\rvert<3$ c) ROC is $\lvert z\rvert<1$	10
5.	Using bilinear Z-transform and frequency pre-warping, design the digital equivalent of a second-order Butterworth lowpass filter, according to the following specification i) Digital filter cutoff frequency = 2kHz. ii) DC gain = 4 iii) Sampling period = 20 micro-second. Write the difference equation relating output and input sequences of the filter. Draw the **Direct form I structure** for realizing the filter.	10
6.	The transfer function of a DTLTI system is given as $H(z)=\dfrac{2-z^{-1}}{1-0.7z^{-1}+0.07z^{-2}+0.015z^{-3}}$ Draw the **parallel structures** for realizing the system. You may use the information that the system has a pole at z=0.5.	10
7.	Write short notes **(any two)** on:	(2X5=10)
a)	Designing of digital filters using Impulse Invariant Transformation	
b)	Region of Convergence (ROC) of z-transform	
c)	"Uniform Sampling" of CT signals as "Impulse Modulation"	