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Ref No:Ex/EE/T/311/2017(S)

B.E. IN ELECTRICAL ENGINEERING 3RD YEAR 1ST SEMESTER EXAMINATION, 2017 (SUPPLEMENTARY)

SUBJECT: - DIGITAL SIGNAL PROCESSING

Full Marks 100
(50 marks for each part)

Time: Three hours

Use a separate Answer-Script for each part

PART I

Marks

Answer any *three* questions

Two marks reserved for neat and well organizes answers

1 . (a) A signal $f(t) = Sin(30\pi t)Cos(90\pi t)$, where t is in second, is sampled with a sampling period of 0.1 second. Determine the frequencies of the harmonic components present in the reconstructed analog signal. Derive any expression used. 8

(b) Starting from the definition of Z-transform, determine the expressions for the Z-transforms and the corresponding regions of convergence (ROCs) of the following sequences. 3+5

(i) Unit step sequence.
(ii) Causal sinusoidal sequence.

2. a) Obtain the expressions for the inverse Z-transforms of *X(z)* given below, for all possible ROCs. 9

$$X(z) = \frac{z-1}{(z^2 - 10.5z + 20)}$$

b) "A uniformly sampled signal can be represented mathematically by an impulse modulated signal'----- Justify or correct the statement with the help of necessary derivations. 7

3. (a) Consider a linear time-invariant discrete-time system with input $x[n]$ and output $y[n]$, related by the following equation. 6

$$y[n] - \frac{7}{12}y[n-1] + \frac{1}{12}y[n-2] = -5x[n] + x[n-1]$$

(i) Determine the system transfer function H(z) if the dc gain of the system is 1.

PART I

(ii) Draw the fully labeled pole-zero diagram for H(z).

(b) The transfer function of a DTLTI system is 10

$$G(z) = \frac{2z^3 - (5/6)\, z^2}{[\, z^2 - (5/6)\, z + (1/6)]\, (z - 1/4)}$$

Derive and draw the following structures for realizing the filter.

(i) Transposed Direct Form II

(ii) Parallel structures using first order subsystems

4. (a) Derive the frequency warping expressions related to the designing of digital filters using bilinear transformation. 6

(b) Using bilinear transformation with frequency prewarping, design a digital filter corresponding to the analog filter with transfer function

$G(s) = 10 / (s^2 + 6s + 5)$ 10

Consider a sampling frequency of 5 Hz.
Derive the frequency prewarping formula.

5. Write short notes on any *two* of the following. 8+8

(i) Regions of convergence (ROCs) of Z-transforms.

(ii) Designing digital filters by impulse-invariant transformation.

(iii) Recursive and non-recursive DTLTI systems.

(iv) Mapping of left-half of s-plane on to z-plane.

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B.E. ELECTRICAL ENGINEERING THIRD YEAR
FIRST SEMESTER EXAM 2017 (Supple)

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 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.	10
(b)	Make comparisons of computational loads of DFT and FFT in detail, for N = 16, 32, 64 and 128.	06
2. (a)	Derive the condition(s) for distortion-less transmission of signal through a filter.	08
(b)	Prove that an ideal digital filter, designed with a real and symmetric h_n, results in a distortion-less filter with zero phase shift.	08
3. (a)	Derive the frequency response of a causal M-tap FIR digital filter, employing a causal, real and symmetric impulse sequence.	08
(b)	Give a detailed account of the processor architecture of TMS320C25. How is multiply/accumulate operation carried out in this processor?	08
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?	06+05
(b)	Prove that for FIR filters in offline operations the length of the output sequence is always smaller than the length of the input sequence.	05
5.	Write short notes on *any two* of the following:	08×2 =16
(i)	Effect of truncation of impulse response of FIR digital filter.	
(ii)	Applications of FFT algorithm.	
(iii)	Fourier series for a periodic discrete sequence.	