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Ref No:Ex/EE/5/T/414/2017(S)

**B.ELECTRICA ENGG. (EVENING) 4$^{TH}$ YEAR 1$^{ST}$ SEMESTER SUPPLE EXAMINATION, 2017**

**SUBJECT: - DIGITAL SIGNAL PROCESSING**

Time: ~~Two hours~~/Three hours/ ~~Four hours/ Six hours~~

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

| No. of Questions | PART I | Marks |
|---|---|---|
| | **Answer any *three* questions**<br>**Two marks reserved for neatness** | |
| 1 a) | Show that a uniformly sampled signal can be represented by a train of scaled impulses, such that the strength of the impulse at every sampling instant is equal to the sample value at that instant. | 8 |
| b) | Consider the bandlimited analog signal<br>$x(t) = 3Sin(200\pi t) + 5Sin(600\pi t)$, *where t is in seconds.*<br>Find the Nyquist sampling rate for the above signal. If the above signal is sampled at 125 Hz, derive the values of the frequencies in the reconstructed signal. Derive the expression used. | 8 |
| 2. a) | Explain, with the help of relevant illustrations, how the left-half of the s-plane maps on to the z-plane. | 10 |
| b) | Starting from the definition of Z-transform, determine the Z-transforms of the following sequences, and show the locations of the poles and zeros of the transforms on the z-plane.<br>(i) $x_n = \left(\frac{1}{2}\right)^n u_n$<br>(ii) A causal exponentially decaying sequence. | 6 |
| 3. | Determine the inverse Z-transform of<br>$X(z) = \frac{5z^2 - 3z}{(z^2 - 4z + 3)}$, for all possible regions of convergence (ROCs) of $X(z)$. | 16 |

| No. of Questions | PART I | Marks |
|---|---|---|
| 4. a) | Discuss the following techniques for designing digital filters and state clearly their salient features<br>i) Impulse invariant transformation<br>ii) Backward difference method | 8+8 |
| 5. | Write short notes on any *two* of the following.<br>a) Frequency spectra of uniformly sampled signals.<br>b) Direct Form structures of IIR filters.<br>c) Discrete-time intregrators.<br>d) Causality and stability of DTLTI systems. | 8+8 |
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Ref No: EE/5/T/414/2017(S)

**B.E.ELE.ENGG. (EVENING) 4TH YEAR 1ST SEMESTER SUPPLE EXAMINATION, 2017**

## 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 neatness.* | |
| 1. (a) | Describe in detail how can you compute discrete Fourier transform of a finite discrete sequence $x_k$, $k = 0,1,2, \ldots, N-1$, where each symbol has its usual meaning. | 11 |
| (b) | What is an $N$-point DFT pair? How can a twiddle factor be utilized in computing an $N$-point DFT pair? | 05 |
| 2. (a) | Derive the expression for frequency response of an $M$-tap ($M$ is an odd number) causal FIR digital filter with a symmetric and real impulse response. | 10 |
| (b) | Differentiate between phase delay and group delay of a filter. Prove that a filter with constant group delay in the pass band region is a distortion-less filter. | 03+03 |
| 3. (a) | Find filter coefficients of a 7-tap causal linear-phase FIR brick-wall type low-pass filter having a pass band gain of unity and a cut-off frequency of 100 Hz. The sampling frequency is chosen as 1 kHz. Apply Hann window for smoothing filter coefficients. Draw the schematic diagram for realizing the filter. | 08 |
| (b) | How can an image be represented as a two-dimensional continuous function of space? | 08 |
| 4 (a) | "In case of FIR digital filters employed for off-line analysis, it is desired that the spacing of the output sequence should be symmetrical with respect to the input sequence." – Justify or rectify the statement. | 04 |
| (b) | In the context of digital signal processors, differentiate between Harvard architecture and modified Harvard architecture, with suitable diagrams. | 06 |

*Ref No:* EE/5/T/414/36/2016

## B.ELE.ENGG. (EVENING) 4TH YEAR 1ST SEMESTER EXAMINATION, 2016

### 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 |
|---|---|---|
| 4. (c) | Describe in detail how can FFT be employed for digital filtering of a finite real data sequence. | 06 |
| 5. | Write short notes on *any two* of the following: | |
| (i) | Low pass and high pass FIR image filters. | 08×2 =16 |
| (ii) | Radix-2 decimation-in-frequency in-place FFT algorithm. | |
| (iii) | Frequency response of Hamming Window. | |