Ref No:Ex/EE/T/322/2017(OLD)

**B.E. ELECTRICAL ENGINEERING_THIRD YEAR SECOND SEMESTER (OLD)-2017**

## 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<br>Two marks reserved for neatness | |
| 1.(a) | Consider the bandlimited analog signal<br><br>$x(t) = 3\sin(200\pi t) + 5\sin(600\pi t)$ , where t is in seconds.<br><br>Find the Nyquist sampling rate for the above signal. If the above signal is sampled 125 times per second, derive the values of the frequencies in the reconstructed analog signal. | 8 |
| ( b) | Two non-interacting causal systems with impulse response sequences<br><br>$h_n=\{0,1,5,-2\}$ and $g_n=\{1,-1,0,-1,1\}$ are in cascade.<br>↑ ↑<br>Determine the impulse response of the combination. | 8 |
| 2. (a) | Explain, with the help of relevant illustrations, how the left-half of the s-plane maps on to the z-plane. | 8 |
| (b) | The response of a digital filter, when excited by a unit step sequence, is<br><br>$s[n] = \frac{7}{6}u[n] - \frac{15}{2}(2.0)^n u[n] + \frac{22}{3}(2.5)^n u[n]$<br>Determine the filter transfer function, and comment on the stability of the filter. | 8 |

[ Turn over

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| No. of Questions | PART I | Marks |
|---|---|---|
| 3 (a) | The transfer function of a DTLTI system is<br><br>$H(z) = \dfrac{2z^3 - z^2}{[z^2 - 0.2z - 0.03](z - 0.5)}$<br><br>Derive and draw following structures for realising the system.<br>(i) Direct Form I<br>(ii) Direct Form II. | 10 |
| (b) | Determine the inverse Z-transform in closed form, of the following.<br><br>$X(z) = \dfrac{5z^2 - 3z}{(z-1)(z-3)}$ ; for $3 > \lvert z \rvert > 1$. | 6 |
| 4. (a) | Using impulse-invariant transformation, design a digital filter corresponding to the analog filter with transfer function<br><br>$G(s) = 10 / (s^2 + 6s + 8)$<br><br>Consider a sampling frequency of 20 Hz.<br>Write down the difference equation relating the output and the input sequences. | 8 |
| (b) | For discretisation of analog filters using backward difference transformation, show with the help of necessary mathematical derivation , how the jω axis in the s-plane maps on to the z-plane. | 8 |

| | PART-I | |
|---|---|---|
| 5. | Write short notes on any two of the following.<br>(a) ROC of Z transforms.<br>(b) Uniform sampling process modeled as impulse modulation.<br>(c) Designing digital filters using bilinear transformation.<br>(d) Recursive and non-recursive DTLTI systems | 8+8 |

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**B.E. ELECTRICAL ENGINEERING THIRD YEAR**
**SECOND SEMESTER EXAM 2017 (Old)**

**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) | 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) | State and prove Periodicity and Symmetry properties of a linear phase digital filter. | 06 |
| 2. | Develop a radix-2 decimation in frequency FFT algorithm for DFT. Also draw the signal flow graph for the same. | 16 |
| 3. (a) | How can FIR digital filters be employed for offline analysis? | 08 |
| (b) | Describe in detail the method of histogram equalization employed for image contrast enhancement. | 08 |
| 4. (a) | How can FFT be employed for digital filtering of a finite real data sequence? | 06 |
| (b) | Differentiate between group delay and phase delay of a distortion-less filter. | 05 |
| (c) | Prove that, if a filter has a linear phase characteristic with offset, then distortion-less transmission of a signal through that filter is possible. | 05 |
| 5. | Write short notes on ***any two*** of the following: | 08×2 =16 |
| (i) | High pass and low pass FIR image filters. | |
| (ii) | Processor architecture of TMS320C25 and its benchmarks. | |
| (iii) | Inverse discrete Fourier transform. | |