



## Advanced Digital Signal Processing & Processors (1010)

P. Pages : 2

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt **any five** questions.
5. Figures to the right indicate full marks.
6. Neat diagrams must be drawn wherever necessary.
7. Assume suitable data if necessary.

1. Compare the single stage, two stage & three stage of the decimator with following specifications. Sampling rate of signal has to be reduced from 10 kHz to 500 Hz. The decimation filter  $H(z)$  has passband edge ( $F_P$ ) to be 150 Hz, stopband edge ( $F_S$ ) to be 180 Hz, passband ripple ( $\delta_P$ ) to be 0.002 and stopband ripple ( $\delta_S$ ) to be 0.001. 20

2. a) What is principal of interpolation ? Derive the expression for interpolated signal at the output. 8

- b) Determine the frequency response, magnitude response, phase response and time delay of the system given by 12

$$y(n) + \frac{1}{2}y(n-1) = x(n) - x(n-1)$$

3. a) Develop cascade and parallel realisation structures for 12

$$H(z) = \frac{\frac{2}{6} + \frac{5}{24} + \frac{5}{24}z^{-1} + \frac{1}{24}z^{-2}}{1 - \frac{1}{2}z^{-1} + \frac{1}{4}z^{-2}}$$

- b) A filter is to be designed with the following desired frequency response 8

$$H_d(e^{j\omega}) = \begin{cases} 0 & -\pi/4 \leq \omega \leq \pi/4 \\ e^{-j2\omega} & \pi/4 < |\omega| \leq \pi \end{cases}$$

Determine the filter coefficients  $h_d(n)$  if the window function is defined as

$$w(n) = \begin{cases} 1 & 0 \leq n \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

Also, determine the frequency response  $H(e^{j\omega})$  of designed filter.

4. a) Show that Bilinear transformation method, ensures one to one mapping of analog frequencies onto discrete frequencies. What is frequency pre warping ? Also convert analog filter with system 10

function  $H(s) = \frac{s+0.1}{(s+0.1)^2 + 9}$  into digital system IIR filter using

bilinear transformation if  $\omega_r = \pi/4$ .

- b) Determine  $H(z)$  for Butterworth filter satisfying the following constraints using impulse invariant transformation with  $T=1s$ . 10

$$\sqrt{0.5} \leq |H(e^{j\omega})| \leq 1 \quad 0 \leq \omega \leq \pi/2$$

$$|H(e^{j\omega})| \leq 0.2 \quad 3\pi/4 \leq \omega \leq \pi$$

5. a) Define parametric & non-parametric methods of power spectrum estimation. Explain the non-parametric methods of power spectrum estimation. 12

- b) Derive the basic LMS algorithm and explain the steps to implement it. Comment on the robustness and convergence of the same. 8

6. a) Find the 4 point DFT of the sequence  $x(n) = \cos \frac{n\pi}{4}$ . 8

- b) Explain the properties of DFT in detail. 12

7. a) Discuss the application of DSP in voice processing. 10

- b) Explain voice privacy in telephone communication system. 10

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