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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent Institution of MAHE, Manipal)

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKE-UP EXAMINATIONS, DECEMBER 2017
DIGITAL SIGNAL PROCESSING [ELE 3102]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 21 December 2017** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed. DSP Quick reference table may be used.

1A. An analog signal is given by $x(t) = 2\sin(250\pi t) + 3\cos(400\pi t) - \sin(600\pi t) + 5\sin(750\pi t)$.

If it is sampled at a rate of 500Hz, determine the generated discrete-time signal. Illustrate aliasing if any. Also find the frequencies of the analog signal that can be re-constructed from this discrete-time signal. ***(04)***

1B. The 8 point DFT of a length 8 complex sequence v(n) = x(n) + j h(n) is given by

V[K] = [–2+j3, 1+j5, -4+j7, 2+j6, –1–j3, 4–j, 3+j8, j6]. Without computing IDFT of V[K] determine the 8 point DFTs of the sequence x(n) and h(n). ***(04)***

1C. If x[n]={1, 2, 0, 3, -2, 4, 7, 5}, evaluate the following:

(i) X(4) (ii) $X(k) = \sum_{k=0}^{7} X(k)$ ***(02)***

2A. Illustrate the over-lap add method for filtering long data sequence for x(n)= [**3**, – 1, 1, 0, 2, 3, 0, 1, -3, 0, -2, 3] and h(n) = [**1**, -1, 1]. Take length of the data block as 4. ***(04)***

2B. An analog signal is sampled at 1024 Hz and 2048 point DFT is computed. If the dominant peaks are observed at k=198 & k=1850, find the corresponding frequency component. ***(03)***

2C. Obtain the parallel form realizations of the LTI system governed by the equation

$$H(z) = \frac{1 + z^{-1}}{(1 + \frac{1}{8}z^{-1})(1 + \frac{1}{2}z^{-1})(1 - \frac{1}{4}z^{-1})}$$ ***(03)***

3A. Find the 8 point DFT of the signal

$x(n) = 3 - |n|$ $-2 \leqslant n \leqslant 2$

$= 0$ otherwise

Use radix-2 DIF FFT algorithm and show all the intermediate values on the signal flow graph. ***(04)***

3B. Sketch the Lattice – Ladder structure for the system $H(z) = \dfrac{1 - 0.8z^{-1} + 0.15z^{-2}}{1 + 0.1z^{-1} - 0.72z^{-2}}$.

Comment on the stability of the system. ***(04)***

3C. Design a FIR notch filter that rejects frequency ω=π/4. Determine the gain such that the frequency response H(ω) satisfies the condition |H(0)|=1. ***(02)***

4A. Design an ideal low pass FIR digital filter using sampling frequency method to satisfy the following conditions.

Pass band: 0-4 kHz

Sampling frequency: 16 kHz

Filter length= 9

Also find the transfer function of the filter ***(04)***

4B. Design a linear phase FIR low pass filter using Hanning window by taking 7 samples of the window sequence and with a cut-off frequency of 0.3π rad. ***(04)***

4C. Compare FIR and IIR digital filters. ***(02)***

5A. Design a digital low pass Butterworth IIR filter using Bilinear Transformation technique to meet the following specifications:

Pass band ripple: 2 dB

Pass band edge frequency: 0.25 rad

Stop band attenuation: 20 dB

Stop band edge frequency: 1.319 rad

Take T=1 sec ***(05)***

5B. Give the advantages and disadvantages of Impulse invariance technique and Bilinear transformation method. ***(02)***

5C. The poles of an analog filter are given by s_1= -2 and s_2 = -0.5. Obtain the transfer function of the equivalent digital filter using impulse invariant transformation. Assume that T=0.01 sec. ***(03)***